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Vol. CXXXII.—No. 3428] LONDON: FRIDAY EVENING, SEPTEMBER 9, 1921 [Price One Shilling By Inland Post 1s. 3d.

PUBLIC NOTICES

G. R.

SUBMARINE LIFTER "CYKLOP" FOR SALE.

The Admiralty have for Immediate DISPOSAL an ex-German SUBMARINE LIFTER "Cyklop," at present lying at Portsmouth.

Brief particulars of the vessel are as follows :—

Vessel consists of two distinct and separate hulls joined by 5 massive overhead girders, which also carry the lifting blocks.

Length of each hull	296ft.
Beam	15ft. 9in.
Distance between two hulls	82ft. 9in.
Mean draught	14ft. 6in.
Approximate displacement	3200 tons

The vessel is self-propelled, one engine and one water-tube boiler being fitted in each hull.

LIFTING APPARATUS.

Total lift, 1000 tons, 200ft.

Five very strong transverse girders connect the two hulls. These girders are connected by heavy fore-and-aft girders. On these fore-and-afters run four trolleys, one between each pair of transverse girders.

Dynamos, air compressors, air bottles, and powerful salvage pumps are fitted. A small workshop is fitted, also accommodation for officers and crew.

Full particulars, facilities for inspection, &c., may be obtained upon application to the DIRECTOR OF NAVY CONTRACTS, Branch 8, Admiralty, Room 25, Avenue House, Northumberland-avenue, London, W.C. 2.

Permission to transfer the vessel abroad cannot be given. 6121

Assistant Mechanical Engineers REQUIRED by the GOVERNMENT of the GOLD COAST for the PUBLIC WORKS DEPARTMENT, for two tours, each of twelve to eighteen months' service, with prospect of permanency. Salary £480 a year, rising by annual increments of £30 to £720 a year, and thereafter by £40 to £920 a year, with an outfit allowance on first appointment of £60. Married men will also be paid during 1921 a special allowance at the rate of £60 a year. Free single quarters and first-class passages. Liberal leave in England on full salary.

Candidates, age 28 to 35, should hold a first-class Board of Trade certificate or be A.M.I. Mech. E., and must have had general engineering experience and be capable of supervising the maintenance of motor vehicles, steam and internal combustion engines, electrical and woodworking machinery. Good experience essential of American motor cars and lorries.—Apply at once, by letter, stating age, and giving brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/G.C. 10,859. 6116

Civil Engineer Required by the GOVERNMENT of HONG KONG, for three years' service as an ASSISTANT ENGINEER in the PUBLIC WORKS DEPARTMENT, with prospect of permanency. Salary £400 a year, rising by annual increments of £20 to £600 a year. Free passages and rent allowance in accordance with Government regulations. Candidates, unmarried, 25 to 30 years of age, must be Associate Members of the Institution of Civil Engineers, who have had experience on the construction of waterworks and in the use of concrete. Preference will be given to candidates who have been trained in a waterworks engineer's offices.—Apply at once, in writing, stating age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Hong Kong, 11,012. 6117

Battersea Polytechnic,
LONDON, S.W. 11.

PRINCIPAL: ROBERT H. PICKARD, D.Sc., F.R.S.,

ENGINEERING DEPARTMENT.

EVENING CLASSES suitable for Final B.Sc. (Eng.), A.M.I.C.E., A.M.I.M.E., &c., are held in the following subjects :—

STRENGTH OF MATERIALS WITH LABORATORY TESTING.
THEORY OF STRUCTURES AND STRUCTURAL DESIGN.
THEORY OF MACHINES AND MACHINE DESIGN.
HEAT ENGINES WITH LABORATORY TESTING.
HYDRAULICS WITH LABORATORY TESTING.

Students enrolled from SEPTEMBER 20th to 23rd. For further information apply to the PRINCIPAL.

DAY TECHNICAL COLLEGE.

FULL-TIME COURSES in MECHANICAL, CIVIL, and ELECTRICAL ENGINEERING for B.Sc. (Eng.) Degree, University of London or College Diploma, COMMENCE SEPTEMBER 27th. Entrance Examination commences September 20th.

Fee £18 per session. 6077

Parish of Lambeth.
BOARD OF GUARDIANS.

The Guardians of the Poor of the Parish of Lambeth hereby invite TENDERS for the PROVISION and INSTALLATION of ELECTRIC LIGHT WIRING and FITTINGS at their Infirmary, Brook-street, Kennington, S.E.

Printed forms of Tender (which alone will be received), with conditions annexed, together with specification, may be obtained at this office on any day (except Saturday) between the hours of Ten and Five, upon payment of £2 in respect thereof, which will be returned to each person sending in a bona fide Tender. The drawing may be inspected at this office and copies thereof may be obtained upon payment of the sum of 1s.

The Tenders, which must be sealed and superscribed in accordance with the instructions set forth on the form of Tender, must be sent to the undersigned or placed in the box provided for their reception in the office of the Clerk to the Guardians by the tenderers or their representatives, should they so desire, on or before Tuesday, the 20th inst., and will be opened in the Board Room at noon on the following day, when all persons tendering or their authorised agents should be in attendance.

The Guardians do not pledge themselves to accept the lowest or any Tender.

By Order,
JAMES L. GOLDSPINK,
Clerk to the Guardians.

Guardians' Board Room and Offices,
Brook-street, Kennington-road, S.E. 11,
1st September, 1921. 6087

The Engineer

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PUBLIC NOTICES

Great Southern and Western RAILWAY (IRELAND).
CONTRACTS, 1921.

The Directors of the Great Southern and Western Railway Company are prepared to receive TENDERS for the SUPPLY of the undermentioned STORES for three months commencing 1st October, 1921 :—

	No. of Form.		No. of Form.
Baskets	10	Glass and China Sundries	27B
Bolts, Nuts, and Rivets	15	India Rubber Goods	9A
Brooms and Brushes	13	Implements, Sundry	21
Brass Fittings for Carriages	18	Iron Tubes and Fittings	29
Do. do. for Lamps	18A	Iron and Steel Wire	30A
Do. do. for Water	28A	Leather	12
Do. do. for Gas	28B	Mats, Fibre	10
Canvas and Sacks	6	Nails	31
Carriage Laces	7A	Plumbago	41
Castings, Malleable	17	Rain Water Pipes and Gutters	25
Coach Screws and Washers	15	Ropes, Twine, and Flax	4
Colours	2	Sewer Pipes, Plaster, &c.	32
Corks	39	Shovels, Spades, &c.	21A
Cotton Waste	5A	Sponge Cloths	5
Crucibles	41	Signal Wire Pulleys	11
Drysalteries	3	Screws and Split Pins	14
Emery and Glass Cloth, &c.	28	Tin Plates	22
Files and Tool Steel	20	Varnishes	1
Fire Bricks and Clay	33	Waste	5A
Foundry Requisites	42	Wicks	5
Grates, Stoves, and Fenders	24	Wire, Fence and Signal	30A
Grindstones	28	Wirework	30B
Glass, Sheet, and Plate	27A		

Forms of Tender can be obtained on payment of 1s. each from the Stores Superintendent, General Stores Department, G.S. and W. R., Inchicore, Dublin. Applications for forms by post must be accompanied by postal order. Stamps cannot be accepted. All inquiries for information should be also directed to the Stores Superintendent.

Patterns may be inspected at the General Stores Department on and after the 9th inst., between the hours of 10 a.m. and 4 p.m. (except on Saturdays).

Tenders must be enclosed in the special envelope supplied for the purpose with each schedule, and must be posted so as to be with the undersigned before 10 a.m. on Wednesday, 21st September, 1921.

The Directors will not consider any Tender unless it is furnished on the Company's form, and do not bind themselves to accept the lowest or any Tender.

By Order,
ROBERT CRAWFORD, Secretary.

Kingsbridge Terminus, Dublin,
September, 1921. 6094

The Madras and Southern MAHRATTA COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for :—

(1) About 314 TONS STEEL PLATES, 3-16in. and 1in.;
(2) About 175 TONS DOG SPIKES and CHAIR SPIKES for RAILS :

in accordance with the specifications which may be seen at the offices of the Company. The charge for each specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, the 20th September, 1921, marked "Tender for Steel Plates," or as the case may be.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices,
25, Buckingham Palace-road,
Westminster, S.W. 1,
2nd September, 1921. 6084

PUBLIC NOTICES

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

No.		Specification fees.
1.	ROOF WORK (Island Platform Roofing, Nagpur)	10s.
2.	WHEELS AND AXLES	£1
3.	COPPER RODS AND INGOTS	£1
4.	BRASS SHEETS, COPPER TUBES, &c.	10s.
5.	FIRE-BRICKS AND FIRE-CLAY	10s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Roof Work (Island Platform Roofing, Nagpur)," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 20th September, 1921.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 7th September, 1921. 6120

The South Indian Railway Company, LIMITED, are prepared to receive TENDERS for the SUPPLY of—

LOCOMOTIVE BOILERS (11).

Specifications and forms of Tender may be obtained at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Locomotive Boilers," must be left with the undersigned not later than 2 p.m. on Wednesday, the 21st September, 1921.

A charge, which will not be returned, will be made of 20s. for each copy of the specification.

Copies of the drawings may be obtained at the office of Messrs. R. White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
7th September, 1921. 6130

Wycombe Rural District Council.
STOKENCHURCH WATER SUPPLY.

TENDERS are INVITED by the above Council for the SINKING of a BORE-HOLE 9ft. diameter from the bottom of the existing public well to a depth of 100ft.; the well is 365ft. deep.

Specification, form of Tender, and other information may be obtained from the Consulting Engineers, Messrs. Lucas and Pyke, 39, Victoria-street, Westminster, S.W. 1, on payment of a fee of £1, which will be returned on receipt of a bona fide Tender.

Tenders, endorsed "Stokenchurch Bore-hole," should be addressed to the undersigned on or before Thursday, the 29th September, 1921.

The Council do not bind themselves to accept the lowest or any Tender.

B. L. REYNOLDS,
Clerk to the Council.

High Wycombe, Bucks. 6115

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.
(Registered under the Trade Union Act.)

An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity. All communications to Head Offices,
H. W. REID, 85, Belgrave-road,
General Secretary. Victoria, S.W. 1.
Ex.

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that ARTHUR HENRY BOETTCHER, of 1550, Monadnock Building, Chicago, State of Illinois, U.S.A., SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 134,445, granted to him for "Improved Pilot Director and Bomb Dropping Sight for Aircraft."

Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents), issued on the 24th August, 1921.

Any person, or persons, may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
6092 Comptroller-General.

Yorkshire (W.R.) Electric Tramways.

APPLICATIONS are INVITED for POST of ELECTRICAL ENGINEER. Only persons of energy and ability and with thorough practical and theoretical training and experience need apply.

A statement of duties and application schedule will be forwarded on request.

H. ENGLAND,
General Manager.

Belle Isle, Wakefield,
6th September, 1921. 6105

SITUATIONS OPEN

MESSRS. BERTRAMS, Limited, St. Katharine's Works, Sciennes, Edinburgh, REQUIRE the SERVICES of a thoroughly competent and energetic MAN to Supervise Workshop. Applicants must have held similar positions of responsibility and must have thorough knowledge of modern methods of economical production. Experience in Papermaking Machinery an advantage.—Apply by letter only, stating age and full experience, with copies of recent testimonials. 6028 A

MESSRS. BERTRAMS, Limited, St. Katharine's Works, Sciennes, Edinburgh, REQUIRE the SERVICES of a resident London REPRESENTATIVE. Applicants must have had practical experience of Papermaking Machinery, including Drawing-office experience.—Apply by letter only, stating age and full experience, with copies of recent testimonials. 6029 A

VACANCY will Shortly be OPEN for ASSISTANT WORKS MANAGER in large Railway Carriage and Wagon Works. Applicants should give age and full experience, which will be strictly confidential.—Address, P4002, The Engineer Office. P4002 A

ARCHITECTURAL DRAUGHTSMAN (Junior) REQUIRED with previous drawing-office experience, knowledge of Building Construction and Surveying and Levelling.

Preference given to ex-Service men.

Write, stating age, experience, salary required, and enclosing recent testimonials, together with evidence of military service, if any, to the OFFICER IN CHARGE OF WORKS, Naval Training Establishment, Shotley, near Ipswich. 6114 A

CHIEF DRAUGHTSMAN WANTED, Man of Proved ability in the Design of Small High-class Repetition Work (press and automatic). Permanent position offered to man possessing the highest qualifications, experience in the above class of work essential. Must be able to control staff of draughtsmen and get best results.—Apply by letter only, giving full particulars, to JOSEPH LUCAS, Ltd., Birmingham. 6048 A

DRAUGHTSMAN WANTED in Yorkshire, West Riding; experienced on Light Railway Wagons, Rails, &c. State full particulars and salary required. —Address, 6112, The Engineer Office. 6112 A

ESTIMATING DRAUGHTSMAN for Structural Steel Works. Applicants must have had similar experience. State age, salary required, and give two references.—NORTONS (Tividale), Ltd., Hecla Works, Tipton. 6093 A

FIRST-CLASS DRAUGHTSMEN REQUIRED, Accustomed to Coal Washing, Screening and Conveying Plant.—Address, giving full particulars of experience and stating age and salary required, 6103, The Engineer Office. 6103 A

SITUATIONS WANTED

WANTED, Active ENGINEERS, Who Already have good connections and are regularly visiting Iron, Steel and Glass Works in the districts of Sheffield, Leeds, Middlesbrough, or Newcastle, South Wales, and South Lancashire, to ACT as AGENTS or REPRESENTATIVES of an ENGLISH CONCERN to negotiate orders for their well-known and highly appreciated GAS FURNACES for re-heating steel or scrap iron piles, melting steel and iron, also for melting glass for bottles, window glass or plate glass.

Address, stating age, qualifications, and experience, P3962, The Engineer Office, P3962 B

ASSISTANT CIVIL ENGINEER (JUNIOR) DESIRES OPENING; technical training, civil and mech. eng.; good draughtsman; exp. surveying, all instruments, &c.—H., 74, Welldon-cres., Harrow. P3980 B

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BRITISH ENGINEERING DEPOTS in FRANCE

RECENTLY PURCHASED BY

Messrs. LEONARD ALDRIDGE & RALPH T. HUGHES.

These Depôts have now been carefully catalogued and all materials examined. To enable English Buyers to see what some of the enormous quantities of Machines and materials are like, various units have been brought over to Messrs. HUGHES, BOLCKOW & CO., LTD.'S Samudas Wharf, Millwall, and shipments to this Wharf will continue regularly week by week as the Machines, etc., are distributed.

The first two cargoes consist of—

Oil Engines; Pumps (hand, petrol and steam); Lighting Sets; Woodworking Machinery; Screwing Machines; Lifting Jacks; Drills and other Tools, in addition to about 80 tons of Lowmoor Iron, Rounds, Flats and Squares; Joists; Rails; Piping; Tanks; Boilers; Engineers' and Carpenters' Tools; Oil Stoves and Lamps; Chain Blocks and Tackle; Barrows; Shovels; etc. Also Textiles in the form of Hessian Canvas; Belting; Netting; Blind Cloth; etc.

Short advertisements will regularly notify arrivals of future cargoes.

All enquiries to be made to—

Mr. H. HARGRAVE, Manager, Samudas Wharf, Millwall, London, E. 14,

or to

Messrs. HUGHES, BOLCKOW & Co., Ltd., 6, Laurence Pountney Hill, London, E.C. 4.

SITUATIONS WANTED (continued)

A.A.—GENTLEMAN (23), Good Address, 6ft., DESIRES any OPENING; electrical and mechanical training; experience covering central station, marine, coal and metalliferous mining plants, steam, Diesel, hot-bulb, petrol and suction gas engines; war service, 5 years commissioned engineer officer, Royal Navy; Spanish and French; open to immediate engagement, home or abroad; min. salary at home £300.—Address, P3982, The Engineer Office. P3982 B

BUYER.—The MANAGER of a Large PURCHASING DEPARTMENT, who has had long and very special experience in this line, DESIRES to NEGOTIATE NEW APPOINTMENT as BUYER or BUYER and STORES SUPERVISOR. Services could be available very quickly.—Write, Z. K. 505, c/o Deacon's, Leadenhall-street, E.C. 3. 6061 B

CHIEF WORKS ENGINEER (Mechanical and electrical), with twenty years' experience amongst large works plants, DESIRES responsible APPOINTMENT. Salary about £650 p.a.—Write, "C. H. O.," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, London, E.C. 6111 B

CIVIL ENGINEER (24), A.C.G.I., Stud. Inst. C.E., ex R.A.F., two years' workshop and drawing-office training, SEEKS APPOINTMENT as Assistant Engineer at home or abroad.—Address, P3978, The Engineer Office. P3978 B

CONTRACTORS' AGENT or PLANT ENGINEER, erection, steelwork, bridges, jetties and large power plants; trained mechanical engineer.—S., 42, Mulgrave-street, Liverpool. P3987 B

ENGINEER, A.M.I.M.E. (32), Abstainer, Well educated, DESIRES CHANGE. Present assistant manager in large works. Disciplinarian, proved organiser, latest methods of production, works lay-out, design, progress, estimating, costing, buying, correspondence, &c.; wants position as Assistant to General Manager, Works Manager or Assistant with progressive firm, where ability will be recognised. Excellent references. Strictest confidence.—Address, P3930, The Engineer Office. P3930 B

ENGINEER (24), Mechanical and Electrical, Hons. B.Sc. (Lond.), A.C.G.I., 3 years shops, 1 year D.O., DESIRES POSITION of responsibility, technical or commercial; excellent references.—Address, P3979, The Engineer Office. P3979 B

ENGINEER (30), Married, Qualified, B.O.T., 12 years' exp. marine, oilfields, factories; honest workman; real need of job, any capacity.—COOPER, 14, Bonner-road, E.C. 2. P3986 B

EXECUTIVE ENGINEER—(CIVIL)—possessing good connections and 25 years' experience on public works construction, shortly OPEN to ENGAGEMENT. Railway, dock, and building experience, including Far East. Charge jobs. Willing to go abroad.—Address, P3970, The Engineer Office. P3970 B

FIRST-CLASS ENGINEERS' CHIEF ACCOUNTANT OPEN for ENGAGEMENT. Accustomed to control large finance department; wide experience accounts, costs, secretarial and company work, also legal knowledge. Good opportunity of securing really capable north country man cheap.—Write, "CONTROL," Box 432, Willing's, 30, King-street, Covent Garden, W.C. 2. 6078 B

GENTLEMEN, A.M.I. Mech. E., A.M.I.E.E., Residing in Lincoln, DESIRES APPOINTMENT as Representative in Engineering, Constructional, Iron and Steel Works.—Address, P4000, The Engineer Office. P4000 B

MECHANICAL ENGINEER, A.M.I.Ae.E., Age 31, 16 years works, D.O., administrative, DESIRES POSITION as Assist. Works Manager, Dept. Manager or similar post at home or abroad; varied experience, general, I.C.E., and small parts production; patentee; progressive position more important than high salary.—Address, P3991, The Engineer Office. P3991 B

A large firm, manufacturing with great success

***A New Core-Sand Binding Material in Powder,* :: ::**

wish to be represented by firms regularly visiting foundries with other articles.

Address, 6091, The Engineer Office.

6091

SITUATIONS WANTED (continued)

INSPECTING ENGINEER DESIRES NEW CLIENTS. Thoroughly experienced rail, pipe and general engineering inspections. Large knowledge home and continental rail and other works, Belgium, Germany, Austria, &c. &c. PERSONAL inspections carried out at short notice. Excellent references. Demobilised R.E. officer, 5½ years' war service. Address, P3980, The Engineer Office. P3980 B

J. E. A. HITCH, A.M.I. Mech. E., Who is About to sever his connection with Alfred Herbert, Ltd., is OPEN to ACCEPT an APPOINTMENT as WORKS MANAGER or equally RESPONSIBLE POSITION.—Address, 40, Queen's-road, Coventry. P3962 B

LAND SURVEYOR (with Own Level and Theodolite) SEEKS RE-ENGAGEMENT in or near London; wide experience in England and the Colonies. Terms £1 1s. per day or by agreement.—BELLAMY, 133, Highbury New Park, N. 5. P3960 B

MACHINE SHOP or WORKS SUPERINTENDENT, wide experience, machine tools, motor car and general engineering; organiser, disciplinarian, and who can show results.—Address, P3976, The Engineer Office. P3976 B

MECHANICAL ENGINEER (48). Ten Years in present position with largest coal and coke company in United States, would LIKE to LOCATE in England. Exceptionally good experience and highest references. State salary offered to save time.—Address, P3934, The Engineer Office. P3934 B

YOUNG MAN (20), Medallist Technical College, DESIRES POSITION with Contracting Firm. Knowledge of structural steel and reinforced concrete design.—Address, P3974, The Engineer Office. P3974 B

SITUATIONS WANTED (continued)

TO CONTRACTORS, &c.—ENGINEER and AGENT REQUIRES an APPOINTMENT; 14 years' experience in charge river and waterworks, slipways, electric power-houses, reinforced concrete, steel-framed structures, and office buildings; also good experience designing.—Address, P3914, The Engineer Office. P3914 B

TO CONTRACTORS AND OTHERS.—CAPTAIN, late Royal Engineers, with extensive pre-war and post-war experience in charge of works, and has carried out several well-known jobs, including nine years' London experience, REQUIRES APPOINTMENT as Manager, Engineer, or Agent with a well-established company.—Address, P3915, The Engineer Office. P3915 B

WORKS MANAGER, with Personal Initiative, 17 years' electrical and mechanical works experience. An organiser used to modern methods of production and sound commercial training.—Address, P3996, The Engineer Office. P3996 B

YOUNG ENGINEER of Limited Experience DESIRES POST under qualified civil engineer, in order to gain experience and instruction in return for services. Salary small.—Address, P3968, The Engineer Office. P3968 B

YOUNG ENGINEER (22) SEEKS OPENING with a good firm; just completed 2-year course mechanical engineering; excellent report. Accept anything affording opportunity to gain experience and show ability.—Address, P3988, The Engineer Office. P3988 B

YOUNG ENGINEER, Stud. I.C.E., 5½ Years' apprenticeship with Messrs. Vickers, general workshop and office experience, technical education in engineering subjects, DESIRES POSITION as Assistant Engineer to Civil or Mechanical Engineer.—Address, P3992, The Engineer Office. P3992 B

SITUATIONS WANTED (continued)

YOUNG MAN (20), B.Sc. Eng. (London), Just Left college, DESIRES CIVIL or RAILWAY ENGINEERING APPOINTMENT to gain experience; wages immaterial.—Address, P3984, The Engineer Office. P3984 B

AS DRAUGHTSMAN.—MECHANICAL ENGR. (25), jig and tool and general, 7 yrs. exp. works and D.O., best refs., SEEKS POST anywhere. Moderate salary with prospects.—Address, P3973, The Engineer Office. P3973 B

AS JUNIOR DRAUGHTSMAN, 3 Yrs. Technical training, thorough knowledge of principles of elect. eng., 2 yrs. D.O. experience.—E. G. S., 32, Springdale-road, Stoke Newington. P3985 B

DRAUGHTSMAN (Mechanical) SEEKS SITUATION in London office. Can speak French and German fluently; workshop experience; age 25.—Address, P3995, The Engineer Office. P3995 B

DRAUGHTSMAN (25), Competent, General Mech. and auto. design, 9 yrs. exp., also estimating, planning, &c., ACCEPT ANY POSITION ANYWHERE (disabled ex-ser.); salary, £5 10s.—Address, P3990, The Engineer Office. P3990 B

ENGINEER DRAUGHTSMAN (28) SEEKS CHANGE; 11 years theory and practice, I.C. engines, compressors, exhausters, and jigs and tools; technical training; go anywhere.—Address, P3975, The Engineer Office. P3975 B

ENGINEERING DRAUGHTSMAN, 7 Years D.O. and 3 years' shop experience, structural steel work and machine design.—Address, P4001, The Engineer Office. P4001 B

ENGINEERING DRAUGHTSMAN (22), with 17 years' shops and D.O. experience, REQUIRES PERMANENT POSITION; well up in general and contractors' machinery, refrigeration, waterworks plant and mechanical filtration.—Address, P3998, The Engineer Office. P3998 B

JUNIOR DRAUGHTSMAN (21), 7 Years' Mechanical workshop and drawing experience; matriculated, City and Guilds certificate; DESIRES POST.—Address, "HYDRO," 72, Hayday-road, E. 16. P3997 B

JUNIOR DRAUGHTSMAN (23), Mech., DESIRES SITUATION; 6½ years D.O. experience; London district preferred.—Apply, E. P., 63, Hampden-road, Hornsey, N. 8. P3927 B

MECHANICAL DRAUGHTSMAN (27) DESIRES POSITION; capable and well trained, making drawings from own measurements, with 5 years' experience, 2½ of which were spent in loco. shops; good references.—Address, P3993, The Engineer Office. P3993 B

TRACER, with 8 Yrs. Experience, Knowledge of plotting from sketches and clerical work in connection with technical.—Address, Miss M., 14, Capel House, 62, New Broad-street, E.C. 2. P3994

SMITHY and FORGE FOREMAN; 12 Years Foreman, marine and general engineering, forge presses, heat treatment, fixing piecework prices, technical training, advanced methods, tactful.—Address, P3922, The Engineer Office. P3922 B

ACCURATE COSTING.—COST ACCOUNTANT, desiring change, WISHES to HEAR from Firm who would appreciate highly skilled work. Moderate initial salary. Please state terms.—Address, P3977, The Engineer Office. P3977 B

For continuation of Small Advertisements see page iv

Susitna River Bridge, Alaska Railroad, U.S.A.

In the construction of the Alaska Railroad by the United States Government, special consideration has had to be given to exceptional conditions arising from deep snow, glaciers and floating ice. An example of how these conditions were met is afforded by the bridge recently completed for the crossing of the Susitna River, which bridge has a total length of 1322ft., with a steel truss span of 504ft. across the main part of the channel. This unusually long span was adopted in order to avoid the extreme probability of destruction of any bridge piers in the channel by the immense pressure of the ice jambs and the deep scouring of the river bed, which occurs when the channel is bridged and blocked by these ice jambs.

The point of crossing is 264 miles north from the terminus of the road at Seward, and 150 miles from the city of Anchorage, which is the main port of the railway, at the head of Cook Inlet. During the winter the Susitna River is frozen over. When the ice breaks up in the spring the great masses moving downstream lodge against islands and bars, and against the shore at sharp bends, forming huge dams, which back up the water until the pressure is so great as to burst the dam. The violent rushes of ice and water would soon destroy timber piers, while concrete piers would be exposed to the double danger of the tremendous pressure from an ice jamb and the undermining likely to occur in the gravel bed when the surface is blocked by ice.

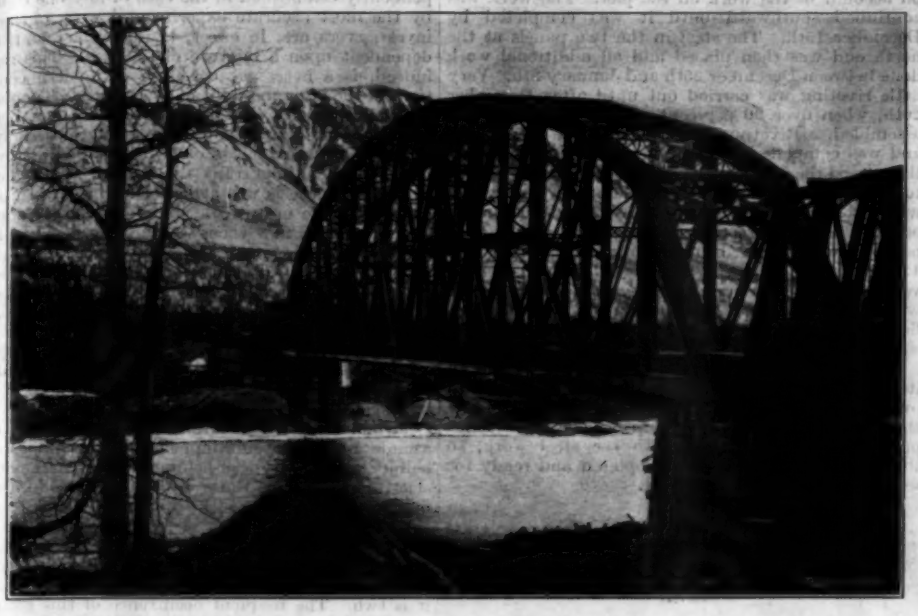


FIG. 1—THE SUSITNA RIVER BRIDGE, ALASKA

Alternative designs were made for a single main span of 504ft. over the dangerous section, and two spans of 250ft., with a concrete pier in mid-channel. As the estimate of cost was slightly in favour of the longer span, there was no doubt as to the adoption of this design on the ground of both economy and suitability. The normal elevation of the water surface is 705ft. above sea level, and the highest known elevation of the ice is 721ft. As the elevation of the base of the rails on the bridge floor is 746ft., the span is high enough to eliminate any danger of its being fouled by ice jambs.

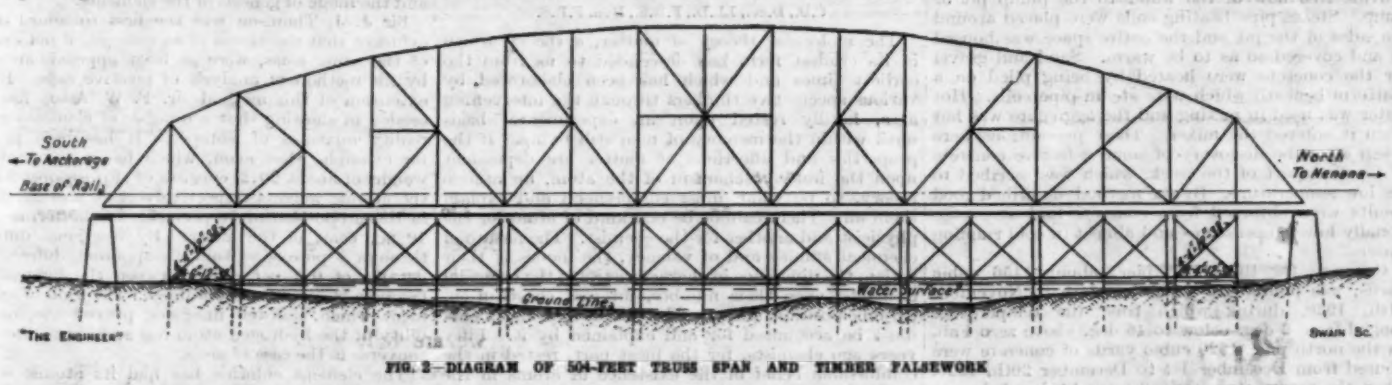


FIG. 2—DIAGRAM OF 504-FEET TRUSS SPAN AND TIMBER FALSEWORK

The construction of the railway and the design of its structures are under the direction of the Alaskan Engineering Commission, of which Colonel Frederick Mears is chairman and chief engineer. Preliminary designs of the Susitna River bridge and its great steel span were made by Mr. J. H. Fogelstrom, formerly bridge engineer of the Commission, and Mr. F. H. Chapin, assistant bridge engineer. The detailing of the span was done by the American Bridge Company, subject to the inspection and approval of Messrs. Modjeski and Angier, consulting engineers. The American Bridge Company also fabricated and erected the steel work.

At the south end the bridge begins with an approach of nearly 400ft. of timber trestle, having 14ft. spans. This work is followed by two timber through truss spans of 70ft. and 121ft., the latter resting on the concrete pier for the 504ft. main span. From the north end of this span there is first a 121ft. and then a 70ft. timber truss span, followed by a short stretch of trestle approach, the total length between abutments being 1322ft. By reason of the high price of bridge steel and concrete work at the time of construction, it was very much cheaper to build all approach spans and piers of timber, but provision is made for future flanking spans of 200ft., each to replace the 70ft. and 121ft. timber spans. All timber and concrete work was done by the railway staff.

The 121ft. timber spans are of the standard design used on the Alaska Railroad, having trusses 28ft. deep, divided into 11ft. bays by vertical rods through the top and bottom booms, which consist each of four timbers of Douglas fir, measuring 8in. by 16in. in section. In each panel are two diagonals, 2in. by 10in. in section, fitted against cast iron blocks bolted to the booms. The trusses are spaced at 18ft. centres, and across the bottom booms are laid transverse pairs of beams, measuring 12in. by 24in. to carry 8in. by 12in. longitudinals, across which the sleepers are placed.

Test borings, 60ft. to 75ft. deep, for the two concrete piers showed varying strata of compact sand and gravel containing large boulders, constituting a good foundation material which would render piles unnecessary. The footings of the piers are reinforced by courses of steel rails. According to a statement prepared by the Alaska Engineering Commission, the construction of these piers was begun in May, 1920, at which time the rail head was within 22 miles of the river. Supplies were transported over this distance by sleds on the river until the ice broke up, and then by boats and wagons until the rails reached the bridge site in September of last year.

FIG. 3—THE MAIN AND APPROACH SPANS

Views of the completed bridge are shown in Figs. 1 and 3, while Fig. 2 shows an outline of the truss design, together with the arrangement of the timber falsework for the erection of the steel. The trusses are of the American pin-connected type, with eye-bars for the bottom boom—except in the end bays or panels—and also for some of the diagonal web members. The top boom is of inverted trough section. Between the truss posts are the transverse plate girder floor beams, between the webs of which are riveted the plate girder longitudinals, across which the sleepers are laid. Fig. 3, taken in May, 1921, shows this main span and its two 121ft. timber flanking spans. In Fig. 1 the concrete pier at the right is still cased in the wooden shuttering.

By that month, also, excavations had been made for the piers and a temporary pile trestle for the railway had been built across the river, 100ft. downstream from the bridge. This trestle enabled the platelaying to be continued across the river and on to the north, while it also provided for traffic and the carriage of supplies without interfering with the erection of the bridge. Piles for the timber trestling and the timber piers for the shorter spans had been driven and the construction of the falsework begun at the north end before the railway reached the river.

Triple-lap wood sheet piling was used at the excavation for the south pier of the main span, and an open caisson or cofferdam for the north pier. Excavation was started in the wet with grab buckets operated by derricks. When compact material was reached, hand excavation was resorted to, the men filling skips which were handled by the derricks. The pits thus formed were excavated to a depth of about 25ft., ditches being maintained around the bottom, so as to drain all seepage water to a sump, from which it was removed by Pulsometer pumps.

Considerable difficulty was experienced in finding sand and gravel suitable for the concrete, as samples from numerous pits were found to contain humus in sufficient amount to make the material unfit for use. Finally, samples from a pit in the glacial moraine in front of the Spencer glacier, 56 miles north of Seward or 200 miles from the bridge, were found to be free from this undesirable element. As the natural material from this pit was deficient in sand, a satisfactory proportioning was effected by the addition of 7 per cent. of sand.

When the cofferdam or foundation pit was unwatered, its bottom was subject to a 22ft. head of water from the river, and by reason of the porous nature of the gravel formation a considerable amount of water was forced through into the pit, which measured 33ft. by 69ft. This flow was too strong to permit of partitioning the pit, pumping it out in sections and placing concrete in the dry. The large area and the coldness of the water—35 deg. Fah. in November—made it impracticable to place concrete under water safely by means of buckets or pipes.

These difficulties were overcome by the use of a sheet of waterproof canvas, prepared in one piece sufficiently large to cover the entire area of the bottom and to extend about 6ft. up each side. This canvas was held in shape by wooden frames, which also kept it far enough away from the sides of the pit to provide free flow of the water to the pump pit or sump. Steam pipe heating coils were placed around the sides of the pit and the entire space was housed in and covered so as to be warm. Sand and gravel for the concrete were heated by being piled on a platform beneath which were steam pipe coils. Hot water was used in mixing and the aggregate was hot when it entered the mixer. These precautions were taken after the discovery of some defective concrete in the first part of the work, which was ascribed to the low temperature. By the method described good results were obtained from concrete laid at exceptionally low temperatures and almost in cold running water.

Concrete for the south pier, about 1456 cubic yards, was poured from October 24th to November 11th, 1920, during which time the temperature ranged from 2 deg. below to 48 deg. above zero Fah. In the north pier, 1520 cubic yards of concrete were poured from December 1st to December 20th, 1920, when the temperature ranged from 12 deg. below to 34 deg. above zero. The pits were kept unwatered during the concreting, and the concrete was delivered in place by means of shoots and vertical drop pipes. Ample time was allowed for the concrete to set before permitting the cold water to come into contact with it.

The timber falsework for the erection of the steel span consisted of alternate single and double rows of piles, forming 20ft. bays, with a spacing of 3ft. for the double rows. In each row there were fourteen piles, capped with 12in. by 12in. transverse timbers and braced by diagonals measuring 4in. by 10in., spiked to the piles. Just above the water line were two horizontal transverse timbers, 6in. by 12in., and upon these rested four lines of longitudinal timbers of the same size, all spiked against the piles. In each bay also there were two sets of diagonal braces of 4in. by 12in. timber, having their ends bolted to the top of the piles in one row and the bottom of those of the other row. This construction made a very rigid and substantial structure to carry the great weight of the steel until the span was completed and supported by the piers. Upon the 12in. by 12in. caps were laid six lines of longitudinals, four of which were 9in. by 18in. in section, and the others 8in. by 10in., to carry the flooring or deck upon which the steel was placed.

The members of the bottom booms of the trusses were laid in position first, then the posts and web members and the floor beams were placed, the top booms following next. Afterwards the lateral bracing and floor system were added and completed the bridge. Most of the steel erection was done by means of a 100-ton locomotive crane with a steel box-lattice jib, 85ft. long. This crane was assisted by a 35-ton locomotive crane with a 50ft. jib, which handled the material in the steel storage yard near the north end of the bridge. The total weight of steel in the 504ft. span is 1805 tons.

To allow the erection of this span to be completed before movement of the ice should endanger the falsework and the span, it was necessary to proceed without waiting for the completion of the piers. One of the 70ft. timber truss spans was used temporarily to cross the excavation for the north pier and so to enable the steel erection and pier excavation to proceed simultaneously.

Steel erection was started on November 8th, 1920, beginning at the north end and at panel point No. 2 on account of the work on the pier. The work was continued southward until it was completed by December 15th. The steel in the two panels at the north end was then placed and all additional work done between December 25th and January 8th. Very little riveting was carried out until after December 20th, when over 90 per cent. of the steel had been assembled. Riveting was then pushed on rapidly, and was completed on February 9th, 1921. During this period the temperature ranged from 42 deg. below to 34 deg above zero, and on some very cold and windy days the riveters did not work. But on one occasion riveting was done on a day when the temperature was 42 deg. below zero in the morning and 12 deg. below in the afternoon. Rivets driven in very cold weather were tested several times during warmer weather, and the work was found to be of first-class character. In all, about 42,200 field rivets were driven.

The span was swung—or made self-supporting on its piers—on February 2nd, and the first train passed over the bridge on February 6th. The erection of the timber spans and the completon of the trestles progressed simultaneously with the steel work, so that the entire bridge was completed and ready for service on February 16th, 1921.

The British Association.

No. I.

THE annual meeting of the British Association for the Advancement of Science opened at Edinburgh on Wednesday evening. Below we give an extract from Sir Edward Thorpe's presidential address—read, in his absence, by Sir A. Ewing—while elsewhere in this issue we reprint the first part of the address delivered by Professor A. H. Gibson, president of Section G (Engineering).

PRESIDENTIAL ADDRESS BY SIR T. EDWARD THORPE, C.B., D.Sc., LL.D., F.R.S., Hon. F.R.S.

The molecular theory of matter, a theory which in its crudest form has descended to us from the earliest times and which has been elaborated by various speculative thinkers through the intervening ages, hardly rested upon an experimental basis until within the memory of men still living. If the properties and affections of matter are dependent upon the inner mechanism of the atom, an atomic theory, to be valid, must comprehend and explain them all. There cannot be one kind of atom for the physicist and another for the chemist. The nature of chemical affinity and of valency, the modes of their action, the difference in characteristics of the chemical elements, even their number, internal constitution, periodic position, and possible isotopic rearrangements must be accounted for and explained by it. Fifty years ago chemists, for the most part, rested in the comfortable belief of the existence of atoms in the restricted sense in which Dalton, as a legacy from Newton, had imagined them. But in spite of the fact that the atomic theory, as formulated by Dalton, has been generally accepted for nearly a century, it is only within the last few years that physicists have arrived at a conception of the structure of the atom sufficiently precise to be of service to chemists in connection with the relation between the properties of elements of different kinds, and in throwing light on the mechanism of chemical combination.

This further investigation of the "superlatively grand question—the inner mechanism of the atom"—has profoundly modified the basic conceptions of chemistry. It has led to a great extension of our views concerning the real nature of the chemical elements. The discovery of the electron, the production of helium in the radioactive disintegration of atoms, the recognition of the existence of isotopes, the possibility that all elementary atoms are composed either of helium atoms or of atoms of hydrogen and helium, and that these atoms, in their turn, are built up of two constituents, one of which is the electron, a particle of negative electricity whose mass is only 1/1800 of that of an atom of hydrogen, and the other a particle of positive electricity whose mass is practically identical with that of the same atom—the outcome, in short, of the collective work of Soddy, Rutherford, J. J. Thomson, Collie, Moseley and others—are pregnant facts which have completely altered the fundamental aspects of the science. Chemical philosophy has, in fact, now definitely entered on a new phase.

The more exact study within recent years of the methods of determining atomic weights, the great improvement in experimental appliances and technique, combined with a more rigorous standard of accuracy demanded by a general recognition of the far-reaching importance of an exact knowledge of these physical constants, have resulted in intensifying the belief that some natural law must be at the basis of the fact that so many of the most carefully determined atomic weights on the oxygen standard are whole numbers. Nevertheless there were well-authenticated exceptions which seemed to invalidate its universality. The proved fact that a so-called element may be a mixture of isotopes—substances of the same chemical attributes, but of varying atomic weight—has thrown new light on the question. It is now recognised that the fractional values independently established in the case of any one element by the most accurate experimental work of various investigators are, in effect, "statistical quantities" dependent upon a mixture of isotopes. This result, indeed, is a necessary corollary of modern conceptions of the inner mechanism of the atom. The theory that all elementary atoms are composed of helium atoms, or of helium and hydrogen atoms, may be regarded as an extension of Prout's hypothesis, with, however, this important distinction, that whereas Prout's hypothesis was at best a surmise, with little, and that little only weak, experimental evidence to support it, the new theory is directly deduced from well-established facts. The hydrogen isotope H_3, first detected by J. J. Thomson, of which the existence has been confirmed by Aston, would seem to be an integral part of atomic structure. Rutherford, by the disruption of oxygen and nitrogen, has also isolated a substance of mass 3 which enters into the structure of atomic nuclei, but which he regards as an isotope of helium, which itself is built up of four hydrogen nuclei together with two cementing electrons. The atomic nuclei of elements of even atomic number would appear to be composed of helium nuclei only, or of helium nuclei with cementing electrons; whereas those of elements of odd atomic number are made up of helium and hydrogen nuclei together with cementing electrons. In the case of the lighter elements of the latter class the number of hydrogen nuclei associated with the helium nuclei is invariably three, except in that of nitrogen, where it is two. The frequent occurrence of this group of three hydrogen nuclei indicates that it is structurally an isotope of hydrogen with an atomic weight of three and a nuclear charge of one. It is surmised that it is identical with the hypothetical "nebulium" from which our "elements" are held by astrophysicists to be originally produced in the stars through hydrogen and helium.

These results are of extraordinary interest as bearing on the question of the essential unity of matter and the mode of genesis of the elements.

Sir J. J. Thomson was the first to afford direct evidence that the atoms of an element, if not exactly of the same mass, were at least approximately so, by his method of analysis of positive rays. By an extension of this method Mr. F. W. Aston has succeeded in showing that a number of elements are in reality mixtures of isotopes. It has been proved, for example, that neon, which has a mean atomic weight of about 20.2, consists of two isotopes having the atomic weights respectively of 20 and 22, mixed in the proportion of 90 per cent. of the former with 10 per cent. of the latter. By fractional diffusion through a porous septum an apparent difference of density of 0.7 per cent. between the lightest and heaviest fractions was obtained. The kind of experiment which Maxwell imagined proved the invariability of the hydrogen atom has sufficed to show the converse in the case of neon.

The element chlorine has had its atomic weight repeatedly determined, and, for special reasons, with the highest attainable accuracy. On the oxygen standard it is 35.46, and this value is accurate to the second decimal place. All attempts to prove that it is a whole number—35 or 36—have failed. When, however, the gas is analysed by the same method as that used in the case of neon it is found to consist of at least two isotopes of relative mass 35 and 37. There is no evidence whatever of an individual substance having the atomic weight 35.46. Hence chlorine is to be regarded as a complex element consisting of two principal isotopes of atomic weights 35 and 37 present in such proportion as to afford the mean mass 35.46. The atomic weight of chlorine has been so frequently determined by various observers and by various methods with practically identical results that it seems difficult to believe that it consists of isotopes present in definite and invariable proportion. Mr. Aston meets this objection by pointing out that all the accurate determinations have been made with chlorine derived originally from the same source, the sea, which has been perfectly mixed for æons. If samples of the element could be obtained from some other original source it is possible that other values of atomic weight would be obtained, exactly as in the case of lead, in which the existence of isotopes in the metal found in various radioactive minerals was first conclusively established.

Argon, which has an atomic weight of 39.88, was found to consist mainly of an isotope having an atomic weight of 40, associated to the extent of about 3 per cent., with an isotope of atomic weight 36. Krypton and xenon are far more complex. The former would appear to consist of six isotopes, 78, 80, 82, 83, 84, 86; the latter of five isotopes, 129, 131, 132, 134, 136.

Fluorine is a simple element of atomic weight 19. Bromine consists of equal quantities of two isotopes, 79 and 81. Iodine, on the contrary, would appear to be a simple element of atomic weight 127. The case

of tellurium is of special interest in view of its periodic relation to iodine, but the results of its examination up to the present are indefinite.

Boron and silicon are complex elements, each consisting of two isotopes, 10 and 11, and 28 and 29, respectively.

Sulphur, phosphorus, and arsenic are apparently simple elements. Their accepted atomic weights are practically integers.

All this work is so recent that there has been little opportunity as yet of extending it to any considerable number of the metallic elements. These, as will be obvious from the nature of the methods employed, present special difficulties. It is, however, highly probable that mercury is a mixed element consisting of many isotopes. These have been partially separated by Brönsted and Hervesy by fractional distillation at very low pressures, and have been shown to vary very slightly in density. Lithium is found to consist of two isotopes, 6 and 7. Sodium is simple, potassium and rubidium are complex, each of the two latter elements consisting, apparently, of two isotopes. The accepted atomic weight of cæsium, 132·81, would indicate complexity, but the mass spectrum shows only one line at 133. Should this be confirmed cæsium would afford an excellent test case. The accepted value for the atomic weight is sufficiently far removed from a whole number to render further investigation desirable.

This imperfect summary of Mr. Aston's work is mainly based upon the account he recently gave to the Chemical Society. At the close of his lecture he pointed out the significance of the results in relation to the Periodic Law. It is clear that the order of the chemical or "mean" atomic weights in the Periodic table has no practical significance; anomalous cases such as argon and potassium are simply due to the relative proportions of their heavier and lighter isotopes. This does not necessarily invalidate or even weaken the Periodic Law which still remains the expression of a great natural truth. That the expression as Mendeléeff left it is imperfect has long been recognised. The new light we have now gained has gone far to clear up much that was anomalous, especially Moseley's discovery that the real sequence is the atomic number, not the atomic weight. This is one more illustration of the fact that science advances by additions to its beliefs rather than by fundamental or revolutionary changes in them.

The true value of any theory consists in its comprehensiveness and sufficiency. As applied to chemistry, this theory of "the inner mechanism of the atom" must explain all its phenomena. We owe to Sir J. J. Thomson its extension to the explanation of the Periodic Law, the atomic number of an element, and of that varying power of chemical combination in an element we term valency. This explanation I give substantially in his own words. The number of electrons in an atom of the different elements has now been determined, and has been found to be equal to the atomic number of the element, that is to the position which the element occupies in the series when the elements are arranged in the order of their atomic weights. We know now the nature and quantity of the materials of which the atoms are made up. The properties of the atom will depend not only upon these factors, but also upon the way in which the electrons are arranged in the atom. This arrangement will depend on the forces between the electrons themselves and also on those between the electrons and the positive charges or protons. One arrangement which naturally suggested itself is that the positive charges should be at the centre with the negative electrons around it on the surface of a sphere. Mathematical investigation shows that this is a possible arrangement if the electrons on the sphere are not too crowded. The mutual repulsion of the electrons resents overcrowding, and Sir J. J. Thomson has shown that when there are more than a certain number of electrons on the sphere, the attraction of a positive charge, limited as in the case of the atom in magnitude to the sum of the charges on the electrons, is not able to keep the electrons in stable equilibrium on the sphere, the layer of electrons explodes and a new arrangement is formed. The number of electrons which can be accommodated on the outer layer will depend upon the law of force between the positive charge and the electrons. Sir J. J. Thomson has shown that this number will be eight with a law of force of a simple type.

The valency of the elements, like their periodicity, is a consequence of the principle that equilibrium becomes unstable when there are more than eight electrons in the outer layer of the atom. The term "atomic weight" has thus acquired for the chemist an altogether new and much wider significance. It has long been recognised that it has a far deeper import than as a constant useful in chemical arithmetic. For the ordinary purposes of quantitative analysis, of technology, and of trade, these constants may be said to be now known with sufficient accuracy. But in view of their bearing on the great problem of the essential nature of matter and on the "superlatively grand question, What is the inner mechanism of the atom?" they become of supreme importance. Their determination and study must now be approached from entirely new standpoints and by the conjoint action of chemists and physicists. The existence of isotopes has enormously widened the horizon. At first sight it would appear that we should require to know as many atomic weights as there are isotopes, and the chemist may well be appalled at such a prospect. All sorts of difficulties start up to affright him, such as the present impossibility of isolating isotopes in a state of individuality, their possible instability, and the inability of his quantitative methods to establish accurately the relatively small differences to be anticipated. All this would seem to make for complexity. On the other hand, it may eventually tend towards simplification. If, with the aid of the physicist we can unravel the nature and configuration of the atom of any particular element, determine the number and relative arrangement of the constituent protons and electrons, it may be possible to arrive at the atomic weight by simple calculation, on the assumption that the integer rule is mathematically valid. This, however, is almost certainly not the case, owing to the influence of "packing." The little differences, in fact, may make all the difference. The case is analogous to that of the so-called gaseous laws in which the departures from their mathematical expression have been the means of elucidating the physical constitution of the gases and of throwing light upon such variations in their behaviour as have been observed to occur. There would appear, therefore, ample scope for the chemist in determining with the highest attainable accuracy the departures from the whole-number rule, since it is evident that much depends upon their exact extent.

The Iron and Steel Institute in France.

No. I.

WE left London by a special train from Victoria at 9.50 on Sunday morning—some three hundred or more of us—and crossed, in perfect weather, from Folkestone to Boulogne. Thence by the Nord to Paris in a special train. The Nord has completely recovered its old-time reputation. The speed was good, the running perfect, and the punctuality all that could be desired. A delightful run, seemingly almost through an endless forest of poplars—white, grey or black, but not Lombardy—with an air of Sunday peacefulness over everything, and by every canal, pond, or river French folk fishing with the old imperturbable patience of before-the-war. The thoughts of the threatened great strike in the North, the thoughts of social upheaval, the thoughts of the battlefields and the economic struggles of Lorraine were miles and miles away from everyone. France, under the September sun, seen sleepily from the carriage window, seemed once again the old, quiet France of the country side, thousands of years distant from the hurrying to and fro of the war, thousands of leagues from the industrial troubles and economic convulsions that we knew were, in fact, disturbing her. It is surely something that in real truth the "Peace of God which passeth all understanding" should be able to settle upon her tired and wounded members for at least one day in the seven and refresh them with perfect rest. Away, no doubt, in great cities, and, perchance, in little wayside *cabarets*, hotheads were vapouring of social revolution just as they do in Hyde Park. But here, all along beside the Nord, were folk quietly fishing in placid waters, a people anxious for a return once more of peaceful, industrious days, people filled with the spirit, the genius of France, which brought them through '70, and which will bring them, more slowly, perhaps, but just as surely, through the troubles of the greater war.

On Monday the meetings opened at the home of the Comité des Forges de France, which is in the Rue de Madrid, off the Rue de Rome. There we sought badges and tickets for the excursions to Lorraine, Normandy and Creusot. These matters being attended to, we assembled in the meeting hall, where Sir Hugh Bell filled the place of the President, Mr. Stead, who, alas! was too ill to be present. Then Monsieur François de Wendel, President of the Comité des Forges, welcomed us in an admirable English speech. It was with Lorraine he dealt especially, and he particularly invited the British iron and steel masters who were going there to try in the short time of their visit to understand the economic problems by which France was faced. Monsieur de Wendel thinks, and thinks rightly, that English people who do not know the district and the remarkable international conditions in which it is involved fail to understand, even to sympathise, with the French attitude. He explained to us in a few telling passages that France felt that but a few miles away there was a country with a population of sixty millions thirsting for revenge, thirsting again for the provinces she had lost, for the iron mines which she had coveted, and for the rich fields she had seized in 1870 and lost in 1918. He asked for the sympathy of England, he asked us all to try and understand, to try to sympathise with France in a very anxious situation. An altogether excellent speech suitably acknowledged by Sir Hugh Bell with expressions of the cordial goodwill which existed between the peoples of France and Britain.

After that Sir Hugh congratulated Monsieur Le Chatelier on the coming of his Jubilee, and Monsieur Le Chatelier, whose name is familiar to all who "meddle with cold iron," briefly replied. Then to Monsieur Fremont, another household word in all parts of the world, the Bessemer Gold Medal was handed with an address, in French, which set forth the benefits he had conferred on mankind by his examinations into the strength of material and his methods of impact testing.

These courtesies disposed of, we came down to the reading of papers; but the sun was shining over Paris, and the audience got smaller and smaller as the morning wore through. An interesting communication by Monsieur Nicou on the iron ore deposits of Eastern and Western France was first presented in abstract by the Secretary, and was immediately followed by an instructive note on the Lorraine and Briey fields, which had been prepared by Monsieur Guillain just before the meeting. In this paper the author seeks to show that Briey ore can economically be sent to England for smelting. The discussion on the two papers was taken as one. Professor Henry Louis was the principal speaker, and the gist of his remarks was that whilst it was true that England did import ore in pre-war times, yet there was no real necessity for her to do so, and the cost of transport was so great that it was unlikely she would. In view of the high price of fuel, what she wanted now was a very rich ore. Mr. Kilburn Scott then asked a technical question or two, and Monsieur de Wendel replied briefly for both authors. He said that his impression, gained on visits to English iron-making districts, was that we did not make the most of our iron ores. Then Sir Hugh Bell had a few words to say about the economics of the question, which brought him to the conclusion that there was enough iron trade in prospect to keep all the ironmasters in the world busy.

So off to *déjeuner*, and afterwards to the laying of a wreath upon the tomb of France's Unknown Warrior by a deputation of the Iron and Steel Institute. After that, nothing till ten o'clock, when the Comité des Forges entertained us splendidly in the Hotel de l'Union Interalliée.

We hope to continue our account of the proceedings and visits in our next issue. Meanwhile we give below abstracts of nine out of the ten papers intended to be read at the meeting. The tenth paper, "An Investigation of Hot Drawing on the Mandrel," by M. Eugène Schneider, was not received in time to enable us to prepare a summary of it for inclusion in this issue.

DAMASCENE STEEL.

By Colonel N. T. Belaiew.

This paper recorded a continuation of the author's investigations into the composition and structure of damascene steel, and the correspondence between it and high-speed steel. Typical damascene articles, according to the author, contained an average of about 1·5 per cent. carbon in the form of Fe_3C or cementite. The cementite forms about 22·5 per cent. of the whole mass, about half being in the free form and the remainder being united with ferrite to form pearlite. The large amount of mechanical treatment to which a damascene blade was subjected resulted in the breaking up of the cementite needles, and subsequently in their complete spheroidisation. The old Eastern makers of damascene steel were very strict about the hammering temperatures, but were, the author believed, not particular as to the subsequent heat treatment. Mechanical treatment also enters largely into the making of high-speed steel with the object of breaking up and evenly distributing the carbides. The author believed that the high-speed steel maker could improve the quality of his product by a scientific application of the spheroidising process.

THE MECHANICAL PROPERTIES OF STEELS AT HIGH TEMPERATURES.

By E. L. Dupuy.

The object of the research dealt with in this paper was to determine the mechanical properties of cast and rolled steels of various carbon percentages at all temperatures between the normal and that corresponding to incipient fusion. Five open-hearth steels with carbon ranging from 0.15 to 1.23 per cent. were selected. Two ingots of each steel were cast. The test bars were cut from one ingot as cast and from the other after rolling. Before the bars were brought to their final diameter of 13.8 mm. they were heat treated in a furnace at 925 deg. Cent. for 1½ hours, and thereafter cooled in still air. For tests at temperatures below 1250 deg. Cent., the bars were placed in a platinum tube resistance furnace, the bars when inside the furnace being protected from oxidation by placing them inside a tubular sheath packed with steel filings or charcoal. For tests at temperatures above 1250 deg. Cent., the heating portion of the furnace used consisted of a carbon tube carrying about 400 ampères at 12 volts. The temperatures of the test bars were measured by means of a platinum and platinum-rhodium thermocouple. When carrying out a test a point 10 deg. above the required temperature was attained at the rate of 20 deg. per minute. The test was made at the end of about five minutes, when the temperature had fallen to the selected value. Summarising the results recorded in the paper, it may be said that in general, as the temperature is increased the breaking stress at first falls off slightly and rises to a maximum at about

300 deg. Cent.—that is, in the vicinity of blue heat. Thereafter it decreases uniformly to just below 750 deg. Cent., although there may be a slight anomaly in the neighbourhood of 450 deg. to 550 deg. At about 750 deg. a discontinuity occurs which is followed in hypo-eutectoid steels by a slight fall in the breaking stress, and then an increase giving a characteristic U-shaped curve. After a slight flattening, the breaking stress then falls until at the commencement of incipient fusion it suddenly descends to zero. In eutectoid steels, the U-shaped branch does not occur, while in hyper-eutectoid steels it is superseded by a curve showing a bend at about 875 deg. Similar results were obtained with regard to the reduction of area observed at the different temperatures.

THE DESTRUCTION AND RECONSTRUCTION OF THE FRENCH METALLURGICAL INDUSTRIES.

By L. GUILLET.

In 1913 50 per cent. of the French coal production and 83 per cent. of the iron ore output was derived from the regions invaded during the war. Of the pig iron production capacity, 64 per cent. passed into the enemy's hands, while 63 per cent. of the steel-making capacity lay on the wrong side of the battle-front. Besides destroying deliberately many important pig iron and steel works, the enemy removed 56,000 tons of ironworks plant and machinery and 51,000 tons of raw and finished materials. After the Armistice, reconstruction was hampered by the impossibility of finding in the immediate neighbourhood any of the materials, and even the labour required, for effecting it. How the situation was met and what has been accomplished at nine large ironworks in the invaded territory was described by M. Guillet in his paper. The author dwelt on the fact that a very large part of the destruction at the ironworks was wrought by the enemy with the deliberate intention of crippling the industry after the war. It is therefore satisfactory to note that much of the machinery stolen by the Germans has been recovered, that advantage is being taken of the reconstruction process to modernise the works, and that the outlook for the industry in the future is as promising and prosperous as that of any other in France.

DOES THE CRITICAL POINT DEPEND ON THE STRENGTH OF THE MAGNETISING FIELD?

By K. HONDA.

Defining the critical point or A 2 transformation point as the temperature at which ferro-magnetism vanished, the author said that the general belief that the position of this point was not affected by the strength of the magnetising field was chiefly founded on experiments made with the magneto-meter. The results obtained by this means were not, he held, sufficiently accurate nor was the range of the magnetising field sufficiently great. Using a torsion balance of great sensitiveness, he had studied the magnetisation of iron and steel in the neighbourhood of their critical points with magnetising fields varying from 400 to 2150. The results recorded confirmed the previous belief that the critical point was not affected by the strength of the magnetising field. The magnetic transformation, he concluded, was very probably a progressive change going on in the molecules themselves with the rise of temperature, and was only one aspect of the internal transformation as revealed magnetically. The critical point of such an internal change would not, he added, easily be affected by an external factor such as a magnetic field.

CONSTITUENTS FOUND IN TUNGSTEN AND MOLYBDENUM STEELS.

By A. M. PORTEVIN.

The practice of annealing followed by exceptionally slow cooling, not only secures a general enlargement of the structural features of steels, but also leads to true states of equilibrium being obtained. The author, by adopting this mode of investigating tungsten and molybdenum steels, has been able to establish the fact that certain structures, regarded as being in equilibrium, are superseded by others, which by the separation of constituents not hitherto described, represent an even more advanced state of equilibrium. In the case of tungsten steel containing 0.4 per cent. carbon and 5.4 per cent. tungsten, the author found, on annealing at about 1300 deg., followed by a cooling extending over 75 hours down to 200 deg., that a network was formed separating regions occupied by a constituent differing from any hitherto known. Under high magnification, this constituent was seen to consist of needles similar to those of the martensite of hardened steels. The author regards them as being a tungstide, Fe_2W. The needle structure persists, even if the steel be re-annealed at about 1000 deg. Cent. In molybdenum steels similarly treated, a similar needle structure was found. The author, however, hesitates to say whether the needles were an iron-molybdenum or an iron-carbon-molybdenum compound.

COALESCENCE IN STEELS AND ITS COMMERCIAL RESULTS.

By A. PORTEVIN and V. BERNARD.

The experiments described in this paper are held to demonstrate that the initial structural state of a steel exerts an important influence on the solution of the cementite during heating, on its precipitation during cooling, and therefore on the general results of softening and hardening treatments. The results obtained are consequently of considerable interest in connection with the ordinary commercial practice followed in the hardening of tool steels. In general the author shows that the hardening treatment of a steel cannot be completely settled by reference merely to its chemical composition; the initial structural state of the steel must also be brought into consideration. It follows therefore that to secure maximum success for the results of the ultimate heat treatment, the steel must by means of preliminary heat treatment be put into the most favourable state for responding to the final treatment. The author urges that rather than vary the final heat treatment to suit the initial structural state of the steel, it is better to adopt a uniform final treatment based on the chemical composition, and to prepare the steel by previously inducing in it a constant structural condition by means of a preliminary heat treatment determined by the antecedent heat treatment history of the steel.

THE CHARACTERISTIC CURVES OF THE HEAT TREATMENT OF STEELS.

By A. M. PORTEVIN and P. CHEVENARD.

In the hardening and heat treatment of steel, the two fundamental factors involved are the temperature of heating and the rate of cooling. By taking these two variables as co-ordinates, the authors' "characteristic curves" of the heat treatment of a given steel are obtained. These curves combine in one diagram the fundamental data of every possible heat treatment, and afford a means of defining accurately the annealed and hardened states of any steel. The Brinell hardness figure was chosen by the authors as the property to be used to define the results of heat treatments. Heat treatment, it was noted, modifies the breaking stress and elastic limit in the same direction as the hardness and the elongation, the contraction of area, the impact resistance and the angle of fracture on bending in the opposite direction. The construction of the characteristic curves, examples of these for typical steels and their significance and value were given and explained.

THE IRON ORE DEPOSITS OF EASTERN AND WESTERN FRANCE.

By P. NICOU.

This paper was originally written for the 1914 meeting of the Institute in France, which, on account of the outbreak of war, had to be cancelled. Many changes have occurred during the past seven years in the relative positions of European iron-making countries. The author accordingly had to bring his paper up to date in numerous respects, and as it now stands it may be said to present a picture of the French iron ore mining industry as it exists to-day, with the greatly enhanced resources added to it by the recovery of Lorraine, with particular reference to the supply of French ore to British ironworks. The paper was lengthy and largely statistical. It, however, afforded a good description of the two greatest iron ore deposits of France, those in the east and those in the west, from which iron ore importing countries can derive their supplies. Both have been, in different ways, seriously affected by the war, and the falling off in their export trade, as compared with 1914, might lead to the supposition that their world value had diminished. This is in no way the case. If the exports to Germany have fallen off considerably, it is largely because for the time being German ironworks prefer to purchase Swedish ore, although it is much dearer, in order that at a later date they may be able to negotiate on favourable terms with those French iron mines which will be feeling the pinch of their diminished trade. These considerations are temporary only and do not in any way affect the question of an export trade between France and Great Britain. While, therefore, awaiting more favourable conditions in the Briey district, British ironworks, the author concluded, could continue in the future as in the past to import into Great Britain those ores of Normandy, Anjou and Brittany which were to-day unaffected by the transitory conditions which rendered the transport charges from eastern France for the moment prohibitive.

THE MANUFACTURE OF SHELLS IN CANADA DURING THE WAR.

By Captain H. W. B. SWABEY and R. GENDERS.

During the war the steel produced in Canada and manufactured into shell forgings and shell components amounted to over 1¼ million tons, and, in addition, 200,000 tons of steel received in the unforged condition from the United States were dealt with. The methods of manufacture followed were, according to the authors of this paper, similar in most respects to those adopted in Great Britain, although there was some variation in the casting of the small ingots for separate high-explosive shells. Chief technical interest in the paper centred in the description of the methods of testing and examining the ingots and shells and of the defects revealed. Some trouble was experienced, as in this country, by the formation of "cones" in the bases of shells forged from a billet by means of a flat-ended punch. If the billet were sound, no mechanical discontinuity occurred between the base of the shell and the cone of metal carried down into it on the end of the punch. But if the billet were unsound, the cone was not in general welded into the base, and could frequently be detached by a hammer blow. The formation of cones was avoided by using a punch the end of which had a contour similar to that of the cone in a sound forging.

Developments in Power Station Design.

No. VIII.*

A GOOD many firms, in addition to those that have been mentioned, are now devoting attention to the construction of oil-burning equipments, and particularly to simple burners which atomise the oil by means of a jet of compressed air or steam. Alldays and Onions, for example, are turning out burners of this class in various sizes, and Fig. 31 is a section of one of the firm's burners suitable for power station

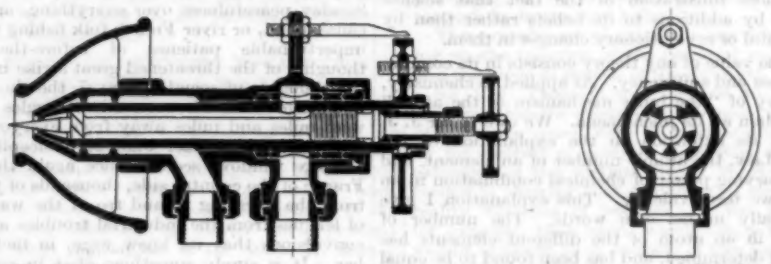


FIG. 31—ALLDAYS AND ONIONS' OIL BURNER

plant use. These burners are composed mainly of gun-metal. The oil is regulated by a needle valve, and the air or steam by a cone valve, as shown, and each valve is fitted with a locking ring. To prevent leakage of oil, the needle valve is provided with a packing gland. The combustion obtained with these burners is claimed to be very perfect, and consequently a minimum amount of oil is consumed for the heat produced. With a properly constructed furnace and a proper supply of air it is said to be possible to obtain a temperature of over 1700 deg. Cent. These oil burners can be fitted to practically every type of boiler. Generally speaking, the fire-bars should be covered with a layer of fire-bricks 3in. thick, and the furnace doors should be replaced by the makers' special fittings, which are constructed so that the air supply to the combustion chamber can be closely regulated, as it is, of course, essential that the proportions of oil and air should be correct for efficient combustion. For mixed firing—i.e., firing with coal and oil—for the purpose of meeting occasional peak loads, the burners are arranged so that they can easily be brought into use during those heavy load periods, and yet not interfere with the coal firing when only a normal load has to be dealt with. This system is only suggested as an emergency method, and is not recommended for ordinary working conditions. The complete oil fuel installation comprises the oil burners, air-inducing cone and regulator, oil strainer on overhead tank with a filter, and when heavy oils are used, a steam coil. A power or hand pump is also provided for raising the oil from the reservoir to the overhead tank. In the case of an installation employing air for atomising a blower or fan is, of course, supplied to provide the air.

About twenty years ago, when the gas companies experienced difficulty in finding a profitable market for coal tar, Colonel Thomas Wilton, of the Gas Light and Coke Company, Beckton, designed a burner for raising steam by burning tar. The original burner was installed on a Lancashire boiler, and remained in operation until other markets were obtained for this by-product. The burner, as originally designed, was of the steam jet type, and possessed novel

* No. VII. appeared September 2nd.

features, as crude tar, as produced at the gasworks, has at times a large water content, and globules of water are disastrous to the working. The burner, which was designed with a view to overcoming this difficulty, has now been improved upon by the Chemical Engineering Company, Limited, of 76, Victoria-street, and it is claimed to be capable of burning all classes of liquid fuel, irrespective of the water content, and at the present time it is being used at the Shelton Iron and Steel Company's works for raising steam by burning blast-furnace creosote.

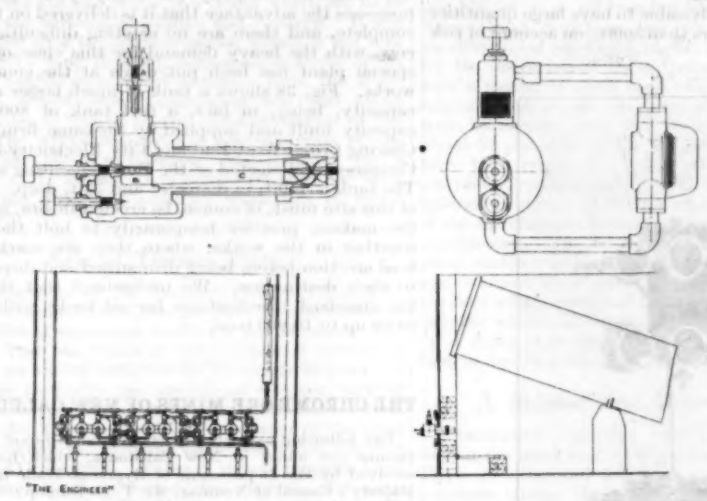


FIG. 32—THE "WILTON" BURNER FITTED TO A BABCOCK BOILER

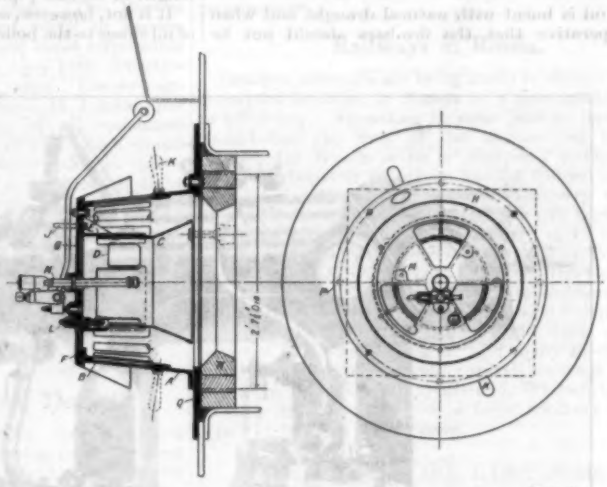


FIG. 33—FURNACE FRONT WITH J. S. WHITE BURNER

The table below gives the performance of the burner under practical conditions.

Test on No. 1 Boiler at Basic Slag Works of the Shelton Iron, Steel and Coal Company, Limited, on May 5th, 1920.

Duration of test	5 hours.
Total water evaporated	15,600 lb.
Total oil used	1519 lb.—146.07 gals.
Average feed-water temperature	111 deg. Fah.
Average steam gauge pressure	94 lb. per square inch.
Average temperature of oil feed	108 deg. Fah.
Actual observed evaporation	10.27 lb. of water.
Pounds of water evaporated per pound of fuel from and at 212 deg. Fah.	11.75
Calorific value of oil	17,381 B.Th.U. per lb.
Boiler efficiency	65.52 per cent.

Analysis of Gases from Down-take Flue during Test.

Time.	CO_2. Per cent.	O_2. Per cent.	CO.
11.40 a.m.	6.6	13.4	Nil.
11.55 a.m.	11.6	8.8	Nil.
12.5 p.m.	7.2	13.0	Nil.
12.20 p.m.	6.6	13.6	Nil.
12.35 p.m.	5.2	15.0	Nil.
3.30 p.m.	3.8	16.6	Nil.
3.45 p.m.	4.0	16.4	Nil.

Temperature of Down-take Flue.

12.45 p.m.	310 deg. Cent. (left)	440 deg. Cent. (right)
3.30 p.m.	—	620 deg. Cent. (right)

The main part of the equipment, apart from the burner itself, is the steam coil, which is inserted in the overhead supply tank, placed at a convenient height above the boilers in order to ensure a good constant feed by gravity into the burner. No pumping arrangements are necessary beyond those that are required to fill the tank, the outlet of which is connected to the burner, the oil pipe being steam-jacketed for a distance of about 8ft. or 10ft. in front of the burner in order to enable the temperature to be raised to the correct value. The supply of oil to the burner is controlled by a needle valve A, as shown in the top left-hand corner of Fig. 32. Around the oil passage is a wire gauze screen, which acts on the principle of the miner's lamp and allows the oil feed to be inspected with safety, at the same time allowing the air to mix with the oil. In the chamber B the oil and the requisite supply of air are picked up by the steam jet, which is also controlled by a needle valve, and the mixture is carried into the Venturi tube C, which increases the velocity of the mixture, which is now composed of steam, air and oil. At the point of greatest velocity the mixture is caused to impinge against a spiral atomiser until it is finally ejected out of the nozzle in the form of a fine spray. An additional steam supply is obtained from a jacket which surrounds the Venturi tube, and this steam, which is also controlled by a needle valve, travels the whole length of the burner, and issues from a circular orifice surrounding the ejector orifice, and the former orifice is so arranged as to direct the steam at an angle so that it impinges on the vaporised oil as it issues from the burner. The value of this secondary steam jet lies in the fact that as the oil spray is heated in the furnace space in the presence of steam, chemical action takes place and greatly simplifies the decomposition of the complex hydrocarbons, and produces a mixture which can be burnt fairly easily and without the formation of smoke.

Provided means are arranged for pre-heating the oil before it enters the burner, it is possible, it is said, to deal with any kind of crude oil and even the heavy oils which may be almost solid at the ordinary temperatures. The lower drawings in Fig. 32 show these Wilton burners fitted to a Babcock boiler capable of evaporating 20,000 lb. of water per hour at a pressure of 160 lb. per square inch. It will be perceived that a multiple system of burners has been adopted so as to obtain a wide range of control over varying loads, ranging from the banked condition to the peak. When it is necessary to clean the burners the oil and steam are shut off and the burner is swung back on its hinges and is cleaned by removing the jet rose and by blowing steam through the atomiser spiral.

The oil-burning equipments made by J. Samuel White and Co., Limited, of East Cowes, operate on the pressure system. From the plan of the burner—Fig. 34—it will be perceived that the oil passes down the centre of the body of the burner to an annular passage surrounding a slotted plate C. This plate is provided with either one, two or three slots arranged to direct the oil in a tangential direction into the whirl chamber at its centre, from which it is discharged through the orifice in the cap B in the form of a fine mist, in which condition it can be efficiently burnt. The plates C and caps B having slots and orifices of varying sizes are supplied to suit varying rates of output. Fig. 35 shows the company's sprayer for burning either hot or cold oil. The construction is very similar to that of the burner just described, which is intended for burning hot oil, but a central spindle D is provided and also means for adjusting it. When the burner is working this spindle protrudes through the orifice in the cap B, as shown in the large scale view. The oil is fed into the whirl chamber in a similar manner to that described above, and on discharging from the orifice in the cap B it impinges on a small head formed on the end of the spindle D, and is broken up into a fine mist, in which condition it can be ignited and burnt without smoke. When using hot oil, the spindle is withdrawn into the position indicated in the sectional elevation by means of a milled cap, when the sprayer operates in precisely the same manner as that used for hot oil, as shown in Fig. 34. The cold oil burner is particularly suitable for lighting up purposes. In both cases provision is made for quickly disconnecting the sprayer, it being merely necessary to unscrew the toggle U when the yoke J springs down and allows the sprayer to be withdrawn. The sprayers can also be adjusted in an axial direction by means of the screw spindle S, and maximum efficiency, it is claimed, can be obtained at all outputs.

The illustration, Fig. 36, shows the arrangement of the pumps and heater. The pumps are in duplicate and for moderate sized installations each pump has sufficient capacity to supply all the boilers, the second pump serving as a stand-by. Fuel is drawn from the storage tanks through duplex suction strainers arranged so that one strainer can be removed for cleaning whilst the other remains in use. The fuel is discharged by the pump through the heater, and thence through duplex discharge filters having fine mesh gauze to prevent dirt, &c., passing into the burners and choking them. These filters are arranged in a similar manner to the suction filters and so that one of the strainers can be removed. A furnace front of a boiler with a burner for use with natural draught in position is shown in Fig. 33, where it will be seen that louvres are provided on the front and periphery of the air box surrounding a cone for the regulation of the air supply, and with this arrangement efficient combustion is said to be secured under

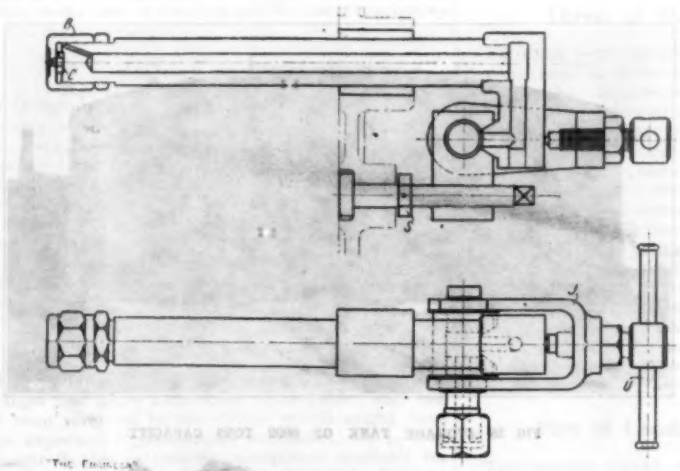


FIG. 34—J. S. WHITE'S BURNER FOR HOT OIL

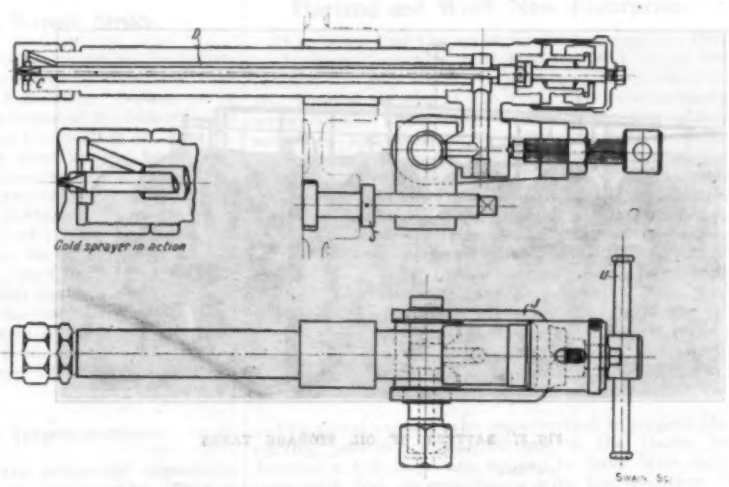


FIG. 35—J. S. WHITE'S BURNER FOR HOT OR COLD OIL

all working conditions. The lettered parts on this drawing are as follows:—A the air box with louvres, B the regulating shutter for the air passing into the air box A, C the air cone with air holes D in the periphery, E a regulating shutter for the air holes at D and G, F the front plate of the air box, which contains the latter air holes, H fire-bricks, J the handle for operating the shutter E, and K the handle for operating the shutter B. L is an adjusting screw for regulating the axial position of the cone C, N the oil fuel burner, P a light screen, and Q an asbestos sheet.

When oil is burnt with natural draught and when it is imperative that the fire-bars should not be removed, the bars are covered with tiles or broken brick and the ashpit is blocked up to prevent admission of air to the underside of the grate, this practice being convenient where very inferior coal is used. Furnaces can be arranged to burn oil or coal with Howden's system of forced draught, and only minor modifications are necessary to make the change.

Cochran and Co., Annan, Limited, of Annan, Scotland, appear to be doing a good deal in the direction of equipping boilers with oil fuel, and have issued some useful notes on the question of storage. Old boiler shells, it is pointed out, make first-class storage tanks. Reinforced concrete tanks can be built to hold very large quantities of oil. Tanks may be constructed wholly of reinforced concrete, or they may consist of a tank supported on a concrete bed. The principal difficulty with underground tanks is to detect and repair leakage, and another disadvantage is that the presence of settled water cannot be detected as readily as when the tanks are exposed. Tanks of moderate capacity may be rectangular or cylindrical in shape, and may be built at ground level or be elevated on towers. Where it is desired to make use of existing coal bunker space for oil storage, tanks may be constructed from sectional cast iron or steel plates. These tanks can be made almost any shape to suit the available space without disturbing existing walls or doorways, and with the minimum outlay on structural alterations. The plates can be obtained from the manufacturers in either cast iron or mild steel, and with either internal or external flanges. Cast iron plates are naturally heavier than the pressed steel plates, but it is claimed that the cast iron is not subjected to the rapid corrosion which wrought iron or mild steel undergoes. Plates with internal flanges give a better external appearance to the tank, but external flanges are easier to keep oil-tight. Oil storage tanks should be placed as close to the boiler-house as possible in order to reduce the length of service piping.

It is not, however, advisable to have large quantities of oil closer to the boilers than 500ft., on account of risk of fire. Regard must, of course, be paid to the manner in which the oil is delivered, and the method by which the tanks can be filled. High ground should always be chosen for oil storage tank sites, not only because this enables proper drainage to be obtained, but also because a certain head then becomes available to assist the flow of oil from the tank. Oil storage tanks must be perfectly oil-tight, and should have a steel or iron roof for preventing the ingress of moisture and grit. Proper means of ventilating the tank must also be provided. The fittings associated with storage tanks are sounding pipes or float gauges, ventilating pipes, steam coils, water drain-pipes and suction pipes, the latter being arranged to draw from a level of at least 1ft. above the bottom of the tank, as this prevents settled water or sediment being drawn into the oil pipes. All pipes draining oil from the tank must be arranged so as to be incapable under all circumstances of syphoning out any of the oil contained in the tank. The ventilating pipes should terminate in a swan neck to prevent admission of dirt or water, and a gauze screen should be fitted across the open end to prevent flames resulting from accidental ignition of the issuing vapours from striking back along the pipe into the tank. Oil may be pumped into the tanks by steam pumps in the case of large installations, or by rotary hand pumps in the case of small installations.

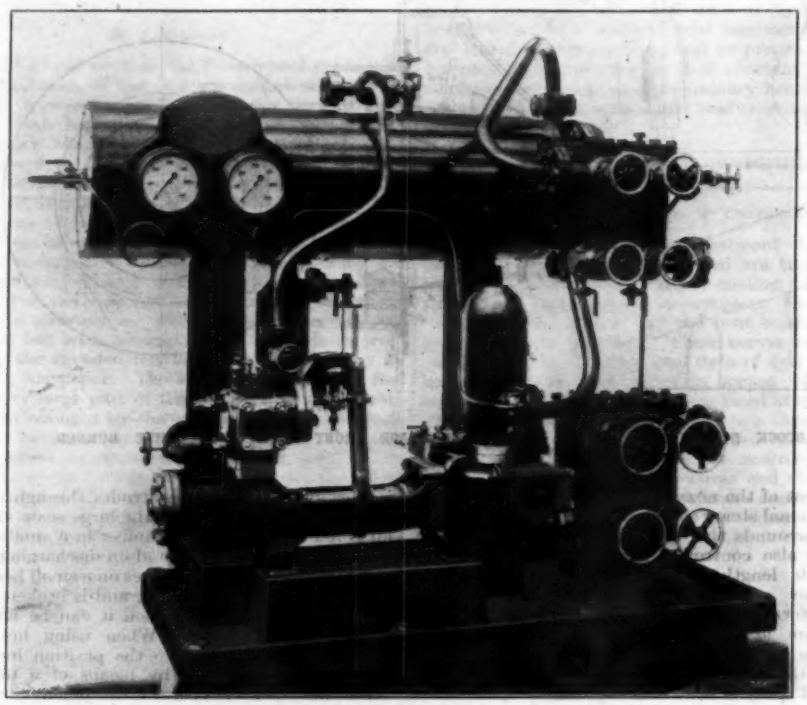


FIG. 36—PUMPS AND HEATER FOR WHITE'S OIL BURNERS

FIG. 37—BATTERY OF OIL STORAGE TANKS

One of the firms that specialises in the manufacture of oil storage tanks is the Whessoe Foundry and Engineering Company, Limited, of Darlington and London, and Fig. 37 shows a battery of the firm's cylindrical tanks, each 9ft. in diameter. Tanks of this description are frequently met with in the road and rail depots of the large oil-marketing companies, and they have also been adopted by a number of electricity undertakings, railway companies, &c. From 4000 to 12,000 gallons of oil are stored in each tank. This type of tank has been turned out by the Whessoe Company for many years past. It possesses the advantage that it is delivered on the site complete, and there are no erecting difficulties. To cope with the heavy demand for this class of tank, special plant has been put down at the company's works. Fig. 38 shows a tank of much larger storage capacity, being, in fact, a fuel tank of 8000 tons capacity built and supplied by the same firm to the Charing Cross, West End and City Electricity Supply Company, and erected at the Bow generating station. The tank is 110ft. in diameter and 33ft. deep. Tanks of this size must, of course, be erected *in situ*, but it is the makers' practice temporarily to bolt the parts together in the works, where they are marked for final erection before being dismantled and dispatched to their destination. We understand that the firm has standard specifications for oil tanks with capacities up to 10,000 tons.

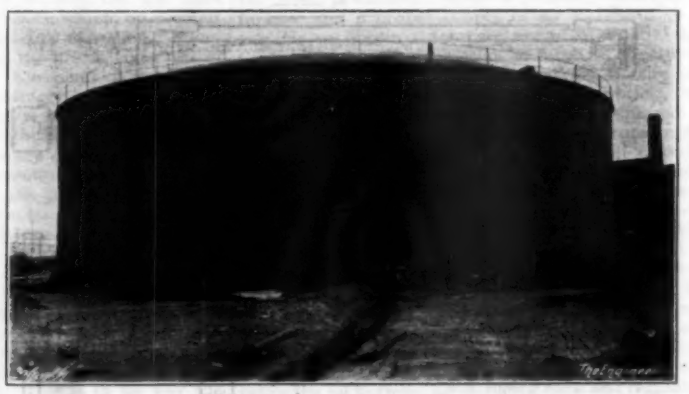


FIG. 38—STORAGE TANK OF 8000 TONS CAPACITY

THE CHROME ORE MINES OF NEW CALEDONIA

The following extracts are taken from a report on the chrome ore mines in New Caledonia, which has been received by the Department of Overseas Trade from his Majesty's Consul at Noumea, Mr. T. D. Dunlop:—

The only chrome mine in New Caledonia from which ore is being extracted at present is the famous Tiebaghi mine, situated at Paagoumene, on the north-west coast. This mine is the richest in New Caledonia, and one of the most productive in the world, for up to February, 1921, some 727,000 metric tons of ore of high grade had been extracted. The heavy shipments to the United States in 1920 practically exhausted the stocks ready for shipment. Several mines at La Coulee, near Noumea, where some 2000 tons are now ready for shipment have been closed down. The ore from these mines has to be washed to bring it up to the 50 per cent. grade. At the Lucky Hit Mine at Plum, 12 miles from Noumea, there are about 4500 tons of ore ready for shipment, and at the Anna Madeleine Mine, situated at Carenage, Prony Bay, about 30 miles south of Noumea, there are some 2000 tons of ore on the wharf. Under an agreement with the owners of the Tiebaghi Mine, these two mines were closed for fifteen years, and have now been reopened. The Société Le Nickel proposes within the next year or so to manufacture ferro-chromium as well as ferro-nickel at Yate on the east coast, when its hydro-electric plant there is completed. The Vercingetorix Mine, situated at Unia on the east coast, 63 miles from Noumea, was opened in 1913, but was exhausted in 1919, by which time 60,000 tons had been extracted, of an average grade of 53 per cent. chromic oxide. Most of the ore was shipped to the United States, but 10,000 tons ready for shipment cannot now be disposed of. Several small deposits are being worked on Belep Island, which lies about 25 miles to the north of New Caledonia. This ore, after washing, is of 60 per cent. grade, the highest in the country. Prospecting still continues, particularly in the south and south-east, but up to the present no additional important deposits have been discovered. No sales are being effected at present, doubtlessly because of the unusually heavy shipments in 1920, which left the United States market over-supplied, and it is feared that the exports in 1921 will be insignificant. The destinations of the chrome ore exported in 1920 were as follows:—United States, metric tons, 87,228; United Kingdom, 1991; Belgium, 1076; Japan, 508; France, 133.

The Department of Overseas Trade is informed that a power-house is to be erected for the Normal School and Institute of Technology, Calgary, Canada, and it is proposed to install a steam-driven generating plant. The boilers have been already purchased, but specifications for the remainder of the plant are not yet prepared. British firms interested should send literature, &c., to the Provincial Architect, Department of Public Works, Alberta.

A Seven-Day Journal.

Clyde Improvement Scheme.

ADVANTAGE was taken of the annual inspection of the harbour and docks of the river Clyde on Tuesday last to visit the site of the new docks which are to be constructed between Shieldhall and Renfrew. It will be recalled that this improvement, which is not now likely to be long delayed, comprises a series of six parallel basins with direct entrance from the river, and the scheme when completed will add about seven miles of quays to the accommodation of the port. The works will involve the diversion of the main road between Glasgow and Renfrew for a distance of 1½ miles. It is estimated that the total cost of the dock and auxiliary work will be about £2,000,000.

Sale of Thames Piers.

THE decision of the London County Council to dispose of some of the Thames piers is a reminder of the decline of passenger traffic on the Thames. The truth is that the business and residential centres of London are in the main too far distant from the river to induce people to use steamboat services, and all attempts to popularise river transport have failed. The London County Council is the owner of the piers at Hammersmith, Putney, Battersea Park, Charing Cross and Greenwich. Three of these structures have been definitely offered for sale, but there are not many likely purchasers of floating piers, and until now it is understood there have been no bids.

Miners' Wages.

FROM the point of view of averting further industrial trouble, it is good news that under the profit-sharing scheme for miners, which was included in the terms of settlement of the recent strike, the men employed in the Eastern Federated Area are already to receive an advance of wages. The area affected includes the coalfields of South and West Yorkshire, Nottinghamshire, Derbyshire, Leicester, Cannock Chase and Warwickshire. It is true that the amount of the increase, 3½d. per shift in the case of adult workers in pits, is small, but it is a beginning and may have the effect of educating many miners who are inclined to scoff at the profit-sharing arrangement on the real merits and the fairness of the scheme.

Engineering Amalgamation.

IF the language employed to announce marriage engagements may be borrowed, it is permissible to state that an engagement has been entered into and a union will shortly be effected between the engineering firms of Fairbairn, Lawson Combe Barbour, Limited, Urquart, Lindsay and Co., Limited, and Robertson and Orchar, Limited. The first-named company has been engaged for many years in the manufacture of machinery for the jute and other branches of the textile trades, and also machine tools for railway shop and other requirements. The other firms, whose headquarters are at Dundee, are engaged in the production of weaving and finishing machinery for the textile trades.

Railway Statistics.

THE details of railway working which appear in the Ministry of Transport statistics for the month of June last bring out with significant clearness the disastrous effect on railway traffic of the coal strike. Freight traffic for the month, as compared with the corresponding period of the previous year, declined by no less than 21½ million tons, or 74 per cent. The decline in the tonnage of general merchandise handed to the railways for trabsport was 40.34 per cent., in coal 88.62, and in other minerals 67.61 per cent. These figures tell their own story.

King of Spain's Aeroplane.

THE advance of the aeroplane as a regular transport medium has been somewhat remarkable, and has not been retarded to the extent which might have been expected by occasional accidents. It is now announced that a touring aeroplane, destined for the personal use of the King of Spain, left Le Bourget aerodrome on Monday last for Madrid. The machine, which is said to have been designed for a maximum speed of 125 miles per hour, has been most luxuriously fitted, and bears the arms of the King-owner.

Oil Burning Locomotives.

THE information recently laid before the South American Section of the Institution of Locomotive Engineers, details of which have now reached this country, indicates that serious attention is being given to the use of oil fuel by Argentine railway engineers. The question is naturally of more importance in such a country than in Great Britain, owing to the fact that reliance has to be placed on imported coal. The Central Argentine Railway, in addition to over fifty coal-burning locomotives converted to the use of oil fuel, has decided to build a considerable number of new oil burning engines. The Buenos Aires Great Southern has about forty in service handling local passenger traffic, and those responsible for the operation of these trains have kept statistics over a period of more than two years. The average consumption of oil has been about 11.1 kilos. per train-kilometre, and the weight of oil consumed about 75 per cent. of the weight of coal which would have been required. When relative calorific values are taken into account, it would appear that a slight balance is struck in favour of coal. The experience of the Antofagasta Railway appears to have been very satisfactory. The mechanical engineer of the company states that oil fuel gave a more satisfactory performance than could have been expected from the best steam coal, and that engines which were only capable when coal-fired of hauling a train of 80 tons up a 3 per cent. gradient were able, when using oil fuel, to handle a train of 230 tons.

A Shipbuilding Rumour Denied.

PERSISTENT rumours have been in circulation during the week that a strong combine in which Lord Pirrie is interested has been in negotiation for the purchase from the Northumberland Shipbuilding Company of the Workman-Clark yards at Belfast. It has been added to give verisimilitude to a rumour which might otherwise have failed to convince, that arrangements have been already made for the extension of the yards under new ownership. While it is not unnatural that Lord Pirrie should be interested in a deal which would consolidate Belfast shipbuilding interests, the secretary of Workman Clark, who has been interviewed, appears to know nothing about the matter. Over and above that the rumour has been categorically denied on behalf of the Northumberland Shipbuilding Company.

The Trade Ship Scheme.

A GOOD deal of interest has been aroused by the scheme for a "trade ship," as it has been termed, which would be specially constructed to form a floating exhibition of British manufactures and is to tour the world to make known to prospective customers the merits of home production. The idea is certainly novel, but it cannot be regarded as unsound. It is being backed by good people, including a well-known firm of shipbuilders, and it is probable that the idea of giving bold advertisement to British wares in this way might give a badly needed stimulus to British trade. The ship is to be a vessel of 20,000 tons and will have four decks for exhibits and accommodation for 300 trade representatives. It will visit South America, China, and Japan, as well as the chief ports of the Empire. Further details of the vessel and her voyage are given elsewhere in this issue.

Threat of Ship Repair Strike.

TROUBLE is threatened at Liverpool by the boilermakers' section of the ship repairing industry. The Mersey Ship Repairers' Federation having given notice that the restrictions imposed by boilermakers on the use of oxy-acetylene burners are to be withdrawn, the men, acting on what appears to be bad trade union advice, have refused to handle the burners and have referred to the action of the Federation as a lock-out. It is, of course, nothing of the kind. The truth is that while the use of the burner calls only for the services of two men, the union rules provide that a whole gang shall be paid for the work. The industry simply cannot stand the tax, and inasmuch as these restrictions on the use of oxy-acetylene burners have been withdrawn in other districts, the Mersey ship repairers are bound to fall into line or lose work. Orders have been already lost from this cause.

Port of London Improvements.

THE annual report of the authority responsible for the operation of the dock system of the Thames shows that although the important Albert Dock extension is, with the exception of warehouse accommodation on the north quay, for which contracts have been placed, practically completed, fresh schemes are taking definite shape. Increased attention is now being given also to the other works in hand. In the London dock area, the acquisition of additional land for extensions is receiving consideration, and it is stated that sanction will be sought in the next session of Parliament for powers in agreement with the Midland Railway to construct a commodious passenger landing stage at Tilbury. The new cargo quay at Tilbury is, of course, already in service. This is a double-deck jetty, 1000ft. long and 50ft. wide, parallel to and at a distance of 160ft. from the shore. A curved railway approach viaduct, 900ft. long and 26ft. wide, is included in the scheme, as good railway access was regarded as an important requirement.

Railways in Russia.

SERIOUS attempts are being made to restore railway transport facilities in Russia to a reasonable degree of efficiency. According to news just to hand from Stockholm, the first of the locomotives built in Sweden for Russia is to be delivered immediately, and the dispatch of others should follow in quick succession. This month also the delivery of locomotives from German manufacturers will begin. For transport purposes use is apparently to be made of the ships owned by the new German-Russian Transport Company, which was formed jointly by the Hamburg-Amerika interests and the Soviet Government. The present position of the railways in Russia is deplorable. Of 19,400 locomotives, over 11,000 were recently reported to be unserviceable, and many locomotives could not be employed owing to the shortage of fuel. It will be recalled that Armstrong, Whitworths were recently in negotiation for a large contract for the repair of Russian locomotives.

Amphibious Tank Experiments.

ON Tuesday of this week an amphibious tank constructed at Woolwich Arsenal met with an accident while endeavouring to cross the Thames in the course of a test. The tank left the Tank Experimental Station at Charlton in the morning, and, arriving at Cross Ness, was driven into the water when the tide was at a favourable height. She had travelled about 300 yards from the shore when, from some cause not revealed, she sank. Her three occupants were safely rescued by a boat in attendance. The tank is to be raised for examination. A few weeks ago, it is reported, the tank successfully underwent flotation tests in a pond.

British Association President.

SIR EDWARD THORPE, the president of the British Association, the annual conference of which opened on Wednesday in Edinburgh, is a Manchester man and a chemist of high repute. He has held many appointments, including the directorship of Government laboratories and of the chemical laboratories of the Imperial College. In addition to his interest in science, which has brought him to the chair of the Society whose object is its advancement, he is by way of being a keen yachtsman. He is a member of the famous Clyde Club and has written interestingly on the waterways of Holland. His occupancy of the chair of the British Association is likely to mark the beginning of a new era of usefulness for that body. The British Association, as it is familiarly termed, is beginning to take itself more seriously and to regard its functions from a new angle.

Harland and Wolff New Enterprise.

IT appears that the arrangement between the Port of London Authority and Harland and Wolff has reached the stage when a beginning will be made with the Thames project of the firm. The maintenance work on the river and the Port Authority plant, workshop, and staff will, it is understood, be formally taken over during the next few days. It is a big scheme, of which only the beginnings are as yet visible. The intention is to make a considerable addition to the ship repairing facilities on the Thames. For many years the work of ship repairing has remained in a comparatively few hands—firms of repute, it will be admitted—and the entrance into the Thames-side industry of the great Belfast firm will do no harm and will certainly be welcomed by shipowners. Harland and Wolff are taking firm root in the ports of Great Britain.

The Jutland Battle Film.

THE naval experts who were invited to inspect the moving picture representations of the Battle of Jutland a few days ago appear to have been duly impressed, but, in consonance with the tradition of the great silent service, have not said much about it. To most people it will appear not only that the reproduction of the incidents of such a sea engagement is almost impossible, but not altogether in the best taste. It is not to be doubted that infinite pains have been taken to put on record the facts as far as they can be shown by cinematography, and the fact that a large number of model ships have had to be built and the whole thing most carefully rehearsed shows that those associated with the production of this film have not stinted money. The film will no doubt be popular; but, having regard to all the circumstances, many will doubt if this kind of thing is really worth the time and money spent upon it by the producers.

The Shipping and Engineering Exhibition.

No. I.

THE outstanding feature about the Shipping, Engineering and Machinery Exhibition, which was opened on Wednesday, the 7th inst., at Olympia, is its readiness for the visitors. We have, in the past, had occasion to explore many exhibitions and shows before they were opened to the public, and throughout our experience we cannot recollect one which was more nearly complete on the appointed day. And this is all the more remarkable in that few, if any, of the stands have seen service before.

Although there are not many real novelties at the show, it is noteworthy that even the most familiar of the exhibits have been staged in such a manner that they attract the attention of the most *blasé* visitor to Olympia. Copper and brass tubes, for instance, are associated with the names of only a few manufacturers and are one of the last products with which one might expect a novel exhibit to be produced. Yet a stand devoted to such materials is, perhaps, one of the most striking at Olympia.

Taken altogether, the general impression left after a tour round the exhibition is to the effect that manufacturers have very little new to display, but that they are rather concentrating their attention on perfecting commodities for which they are already known, and, at the same time, are using every endeavour to attract the attention of new customers to their wares.

The title of the exhibition suggests that shipping matters might be predominant among the exhibits, but the contents of Olympia are, in fact, of a most catholic nature, and might be, we think, quite properly grouped under the one heading of engineering products. We commence below a review of some of the more noteworthy exhibits at the show.

STEAM AND WATER METERS.

George Kent, Limited, of 199–201, High Holborn, London, W.C. 1, are exhibiting a distinct novelty in the form of a water level indicator which automatically calls out the water level at its station when

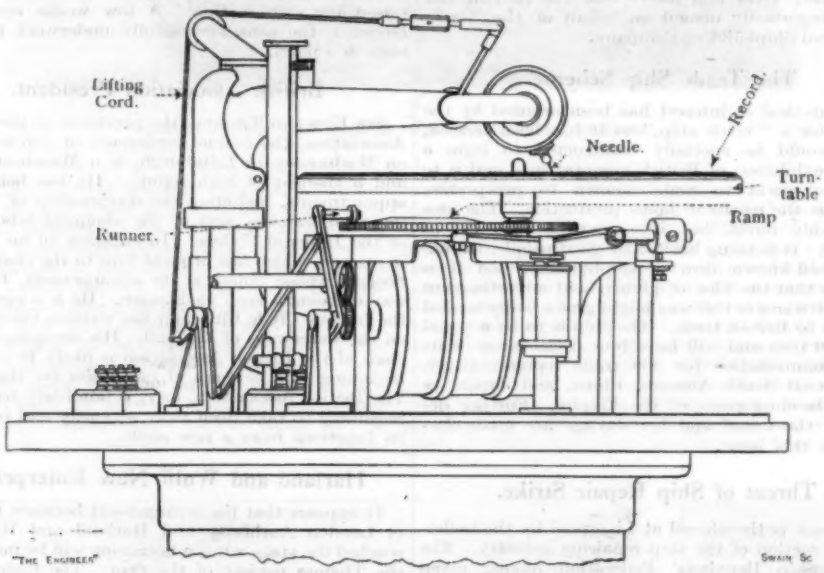


FIG. 1—KENT'S GRAMOPHONIC WATER LEVEL INDICATOR

it is rung up over the telephone. The instrument thus possesses the great advantage, over the usual form of indicator which only signals the upper and lower limits of level, of enabling the person interested to get an idea of the actual amount of water available at any moment. Also, on account of the fact that the instrument can be used in conjunction with the ordinary G.P.O. telephone circuits, anyone who knows the number assigned to the instrument by the telephone exchange can get an indication of the water level, so that the engineer of a waterworks, for instance, could ascertain the level in the reservoir from his private house.

The indicator is made in two forms, one of which gives its indications by means of a gramophone record, while the other signals telegraphically in dashes. It is the first-mentioned type which is illustrated in Fig. 1. The apparatus consists essentially of a gramophone clockwork mechanism working in conjunction with a level-recording gear, the whole being mounted on a galvanised wrought iron pedestal. The mechanism is enclosed in an iron case, fitted with a padlock and key. By the movement of a float resting on the water in the reservoir, the tone arm, sound box and needle are moved laterally into a position relatively to the disc which gives the correct reading when the needle is brought into contact with the disc. To bring the needle in contact with the disc a sprocket wheel is geared with the disc spindle of the clockwork mechanism; this sprocket is fitted with a platform on which a runner travels down a small ramp; by a system of levers and cord the sound box with the needle is automatically lowered, when the mechanism is in rotation, on to the disc, and again raised above the disc when the mechanism stops. The recording disc has 200 concentric circles which are "vocalised" to announce the water level in percentages from empty to full. The makers say that the machine can be rung up 100 times for one winding of the clockwork, and that the needle of the

FIG. 2—KENT'S BI-CONTROL WATER METER

gramophone should not require changing more often then every twenty times the machine is wound up.

Another new meter which is being shown by George Kent is the bi-control inferential meter shown in Fig. 2. The chief feature in its design is an automatic gate control, placed in the entrance to the meter, which, while ensuring great sensitiveness on normal flows, permits adjustment to be made for continuous fine flows without adversely affecting the performance of the meter on full discharges. This adjustment takes the form of a small flap valve, against the back of which a stop can be screwed down to any desired extent. Means are also provided for counteracting loss by wear and tear after long periods of work; adjustment can be made from outside the meter without breaking the pipe connection or opening up the meter. The steam meters exhibited on this stand have already been described in THE ENGINEER.

THE B.T.H. EXHIBITS.

Among the many exhibits of the British Thomson-Houston Company is a double master controller for cranes. This controller enables all operations of the crane to be controlled by one man from the deck or dock side where a full view of the load can be obtained during all stages of loading and unloading cargo. The operator carries the controller by means of straps which pass over his shoulders so that he can take up any desired position and still control the load. A light cable connects the controller to a set of contactors mounted on a panel in the crane cabin, and these contactors are, of course, operated by the portable master controller. It is claimed that the system not only reduces labour, in consequence of the absence of a man to direct operations, but the loading and unloading speeds can also be increased.

The "B.T.H." electric rivet heater, shown in Fig. 3, is composed of a portable light iron framework which supports a compact air-cooled transformer having the primary connected through a six-step drum controller to the alternating current supply. The secondary of the transformer is connected to two movable copper electrodes which can be raised or lowered by means of foot pedals so that rivets may be held between these electrodes and a fixed copper block below them. By means of the controller six distinct rates of heating can be obtained to suit

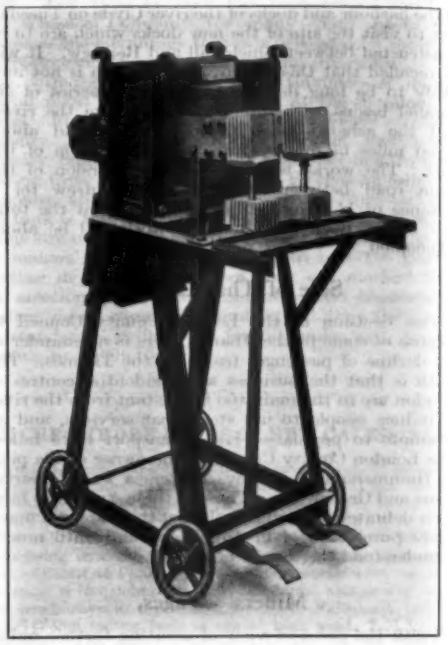


FIG. 3—B.T.H. ELECTRIC RIVET HEATER

various sizes of rivets or any desired output. The machine will heat any size of rivet from ¾in. to 1¼in. in diameter and from 1in. to 5in. long. Owing to the fact that the heat can be controlled accurately, waste is reduced to a minimum. Moreover, as the rivets are not subjected to the effects of the fuels usually employed, they remain clean and practically without scale.

The double master controller shown in Fig. 4 is

FIG. 4—B.T.H. DOUBLE MASTER CONTROLLER

another of the company's exhibits, and is designed for use in connection with cranes and similar machinery. It is intended for controlling two motors at the same time, and allows both the travel and transverse motions to be controlled by a single lever. It will be gathered that the controller has two small drums which are operated by the same lever through universal gearing. When the lever is in the vertical

position, as shown, the barrels are in the "off" position, but if desired, the controller can be constructed so that the current is off when the lever is in the horizontal position, and a spring can be provided for returning the drums to this position automatically. These controllers are designed to operate in conjunction with contactors. A water-tight controller is also exhibited.

Another useful device which is on view is the pedal switch—see Fig. 5—for controlling electrically operated capstans, winches, &c., the obvious advantage of a switch of this sort being that it leaves the operator with both his hands free. The pedal plunger passes through a water-tight gland, and when the switch is assembled on a capstan pit cover, for example, it is entirely impervious to rain and sea water. This switch, like the controller just described, is designed for use in connection with contactor gear. When the switch is out of service the plunger can be disengaged from the operating mechanism, dropped flush with the surface of the switch, and the pedal can be locked by inserting a key in the top of the plunger.

Of the alternating starting equipments that are exhibited the most interesting is perhaps the B.T.H. automatic compensator, which, whilst similar in principle to the hand-operated auto-transformer starter, differs from the latter in respect to the change-over switch, which is replaced by contactors. Any form of auxiliary switch can be used to start or stop the motor, such as a push button, float switch, pressure governor, pedal switch, &c., the operation of which has the effect of closing the starting controller. An auto-transformer with tappings gives a variable voltage between 40 and 80 per cent. of the line voltage, and any one of the three or four tappings can be brought into use to suit the particular load. As soon as the motor attains a certain speed a current-limiting accelerating relay operates and opens the

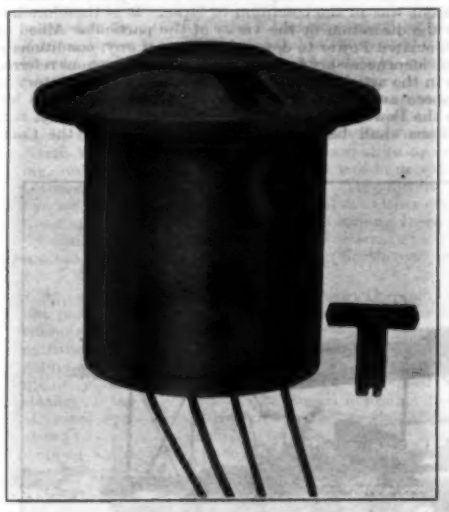


FIG. 5—B.T.H. PEDAL SWITCH

starting contactor and closes the running contactor which connects the motor directly across the line. Oil-break three-phase alternating-current switches for mining and industrial service, and designed on the draw-out principle, are also exhibited. These switches are provided with simple interlocking devices which prevent accidental contact with live metal, and also ensure that the switches are isolated from the line before they can be opened up for inspection. The oil switch instruments and automatic devices are mounted on a sliding carriage and are connected to the bus-bars or cables through plug contacts. The switches cannot be held in the closed position during times of short circuits or overloads. In fact, every possible protection is provided to minimise the risk of accident through ignorance or forgetfulness.

The company's flow meters which are exhibited are suitable for measuring steam, gas, air, water or oil, but these meters are, of course, fairly well known. Other exhibits which are also familiar to most engineers are the company's Fabroil pinions, which are shown in many forms, including double helical examples. These pinions are claimed to be unaffected by climatic conditions, and do not expand or shrink with extreme dryness or humidity. Another exhibit, shown in Fig. 8 on page 266, is the B.T.H. portable wireless receiver, which is an extremely light and compact unit, weighing only 20 lb., measuring 13in. by 14in. by 5in., and not requiring an external aerial or other wires. All that is necessary when putting the apparatus into use is to stand the box on a pivot and to connect up the telephones, when by a simple adjustment, the apparatus is tuned to the vibrations of the passing wave. The signals are said to be sufficiently loud to enable messages to be taken from stations in France and Germany, and the direction and origin of the signals are indicated by the instrument. The case contains a receiving coil, an adjustable condenser, two receiving valves or vacuum bulbs, an accumulator for heating the valve filaments, dry cells for the telephone circuits, two small transformers, and a hinged frame which carries a coil.

There is naturally a display of Mazda lamps and "Mazdalux" reflectors for industrial lighting. For flood lighting the firm is exhibiting several projectors, and one type is shown in Fig. 6. The projector is fitted with a high candle-power incandescent lamp, which throws a beam of light to a considerable distance. This system of lighting is intended for conditions where it is required to illuminate a given area from a considerable distance, and especially for the lighting of advertisement hoardings, monuments, and the facades of public buildings. The projectors are made in several sizes, and are provided with either a tripod

FIG. 6—B.T.H. FLOOD LIGHT PROJECTOR

base or a universal bracket. Marine type projectors are supplied with mountings suitable for attachment to the rail of a ship or to the rail of the navigating bridge.

Pipe Joints.

The new form of pipe joint which was shown at the last Engineering Exhibition by the Victory Pipe Joint Company, of 28, Victoria-street, Westminster, is again being exhibited, but during the intervening two years several detail improvements have been made in its construction. The views given in Fig. 7 indicate two of the latest types of joint. That on the left is the standard "floating" form, that is to say, the two adjacent lengths of piping are more or less free to move longitudinally. The "location" type, shown on the right taken apart, is devised to accommodate any end thrust which may come on the pipe. In both cases the actual fluid-tight joint is made in the same way and with much the same type of elastic ring, illustrated in our issue of October 17th, 1919, in which the pressure of the fluid is used to increase the tightness of the grip of the edges of the ring. The exterior shape of the ring has, however, been slightly modified so that the joint will resist external pressure—maintain a vacuum inside the pipe—as well as it will resist internal pressure. This feature is obtained by sloping the end faces of the ring in such a manner that external pressure tends to jamb the ring more tightly between its housing and the pipe, and is naturally of great advantage in such situations as those in which a water main, for instance, may be occasionally drained out dry. To return to the two distinct types of joint, the floating type is slipped over the plain ends of the two pipes and the ends are left a slight distance apart, with the result that the pipes are free to expand or contract, within reason, without impairing the joint. At the same time the flexibility of the ring and the clearance in the housing permit an angular movement of the pipes to the extent of 3 deg. on either side of the centre line. Flexibility is maintained in the location joint, but end movement is prevented by the housing engaging with shallow grooves cut in the ends of the pipes. In this case it is, of course, necessary to make the housing in halves, which are held together by a ring being driven home on the conical outer face.

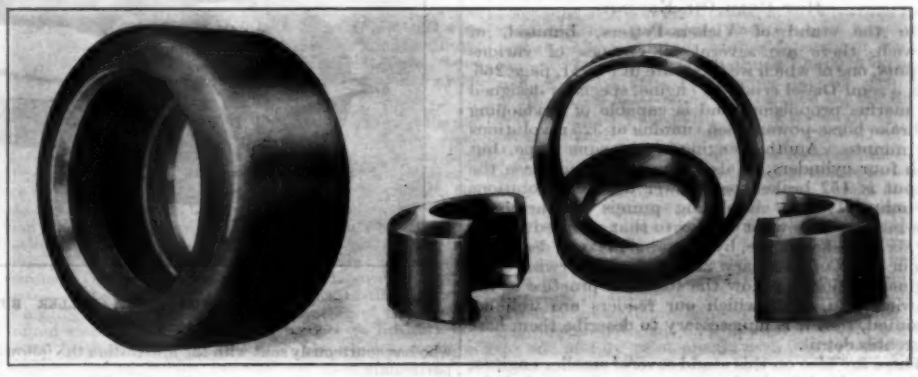


FIG. 7—TWO TYPES OF VICTAULIC PIPE JOINT

The material of which the Victaulic rings are made has been the subject of considerable investigation; several different classes have been evolved for various conditions, and one is now available which the makers say is quite satisfactory for steam temperatures up to 350 deg. Fah.

Among the more recent applications of the joint are the jointing of the two parts of steel barrels, which may be separated and nested for transport when empty, and the connection of small pipes working under low pressures in the most simple manner. For the latter purpose the joint ring is reinforced with canvas, and thus does not need a housing. The joint is merely slipped over the ends of the pipe and the joint is made.

One of the great merits of the Victaulic joint is its adaptability to plain cylindrical pipes, a fact which suggests that it may be of great assistance in popularising reinforced concrete pipes for many purposes. One of the chief objections to concrete as a material for pipe-making is its lack of elasticity, which results in cracks if the pipe line is bent by subsidence of its support, or any other cause. The new joint can be applied, we are told, to any ordinary concrete pipe without special preparation of the surface at the joint and its flexibility is sufficient to accommodate all ordinary foundation subsidences without overstressing the pipes.

Ship's Bridge Indicators.

Siemens Brothers and Co., Limited, are showing various electrical contrivances for use on ships, such as engine-room telegraphs, loud-speaking telephones, helm and navigation light indicators, a look-out indicator, a revolution indicator, a water depth indicator, a torsion meter operating on the Hopkinson-Thring principle, a Forbes' ship's log and speed indicator, a Hamill flow meter, wireless telegraph installations, distance pyrometers and thermometers, &c. The current for operating the telegraphs which are shown in operation is independent of the ship's electric power circuits, being obtained from a primary battery which always remains in circuit. The apparatus is claimed to be absolutely positive in action and to be easily installed, as the cable connections can be run along any convenient path from the bridge to the engine-room. For large vessels the system has been found to be very advantageous.

The loud-speaking telephones are intended to provide communication between the bridge and the various parts of a ship, including the engine-room. A very small current is said to be sufficient for working these loud-speaking instruments, and by the adoption of the Siemens "Inert" cell renewals are rarely necessary.

The navigation lights indicator shows whether the navigation lights of a ship are burning correctly and when one filament of any of the double-filament lamps is broken. On the front of the case containing the apparatus is a plan of the ship's deck, with circular windows in positions corresponding to those of the navigation lights, and behind these windows are indicating lamps. If one of the filaments of a navigation lamp should break, the brilliancy of the indicator lamp corresponding to that particular navigation light diminishes, and when both filaments of a navigation light are broken, or if, on account of some other defect, the current in the circuit is interrupted, the indicating lamp is completely extinguished

and at the same time an electric bell is put into operation.

By means of the revolution indicator it is possible for the officer on the bridge of a ship to ascertain the exact movements of the ship's engines, for it shows when the engines start or stop, and also the direction in which they are running. The water depth indicator gives the depth of the water in the various tanks of a vessel, and comprises a transmitter which is operated by the pressure due to the height of the water in each tank, an indicating instrument, and a selector switch for enabling any one of the transmitters to be connected to the indicator. The distance of the tanks from the central position where the readings are taken does not, it is said, affect the accuracy of the instrument. As regards the Hopkinson-Thring torsion meter, this instrument is, of course, well known and scarcely calls for comment. The Forbes' ship's log and speed indicator gives the distance travelled by the ship as well as the actual speed through the water at any moment. The receivers, which consist of distance recorders and speed indicators can be fitted in any desired position in a ship, and are operated electrically. Any number of receivers up to ten sets can be operated from one transmitter. The Hamill flow meter measures the rate of flow of petrol, oil or similar liquids, and is unaffected by varying pressure, head, size or conditions of pipes or vibration and can be used for measuring the fuel consumption of petrol or Diesel engines, the flow of water in cooling jackets and the flow of oil to turbine bearings, &c.

One of the wireless exhibits is a cabinet type transmitting and receiving outfit suitable for use on small vessels. When no electrical installation is available for charging the battery the charging current is supplied by a .3-kilowatt direct-current generator driven by a petrol engine. The length of the waves emitted by the transmitter can be very accurately adjusted. An aural receiver with a contact detector has a wave range of from 200–2000 m.

Fuel Oil Burners.

On the stand of J. I. Thornycroft and Co., 10, Grosvenor-place, London, S.W. 1, there is a working model of the makers' system of oil burning, of which we gave an illustrated description in our issue of September 2nd last. A model furnace front is shown, fitted with a Thornycroft oil fuel sprayer, through which water is being pumped to show the device in action, and demonstrate the very fine spray it produces in effecting the atomisation of the oil. In addition, there are a complete pumping and heating set for an output of 1000 lb. of oil per hour, and a stationary boiler furnace front fitted with Thornycroft sprayers for oil fuel burning.

One of the most noteworthy exhibits on the Thornycroft stand is a stationary motor set complete with its dynamo for use as a ship's emergency lighting equipment, which we illustrated in Fig. 10, page 266. This unit has a Thornycroft six-cylinder motor developing 75 brake horse-power on paraffin fuel, coupled to a dynamo with a normal output of 36 kilowatts and maximum on overload of 42 kilowatts, with a voltage of 110–220. Both engine and dynamo are mounted on a substantial bed-plate and are provided with a radiator and fan, forming a compact unit capable of generating sufficient current to light the largest liner afloat. A range of Thornycroft propellers is on view, together with a collection of models of various types of mercantile and pleasure boats, built by the firm.

Hot Bulb Oil Engines.

On the stand of Vickers-Petters, Limited, of Ipswich, there are several oil engines of various outputs, one of which we illustrate in Fig. 11, page 266. It is a semi-Diesel crude oil engine, specially designed for marine propulsion, and is capable of developing 54 brake horse-power when running at 325 revolutions per minute. Another engine of the same type, but with four cylinders, is also shown. In this case the output is 152 brake horse-power at 300 revolutions per minute. The circulating pumps are arranged in a manner somewhat similar to that adopted for the big six-cylinder engine, by the same makers, described in our issue of February 25th last. Otherwise these engines so closely follow the standard practice of the Ipswich firm, with which our readers are well acquainted, that it is unnecessary to describe them here in greater detail.

There are also on this stand several smaller engines, such as a 13.5 brake horse-power unit, coupled, by means of a friction clutch, with a two-stage compressor by Reavell and Co., a Petter Junior engine of 2½ horse-power driving a 1-kilowatt continuous-current generator by means of a belt, and a 5 horse-power marine engine. In these small marine sets the fuel tank is embodied in the base-plate, which is extended to carry the reversing gear, so that the whole propelling unit is on one base. Besides some component parts, there is also a small demonstration plant at work to show the working of the makers' system of starting engines by means of an electric torch, the essential features of which we have already described.

Electric Arc Welding.

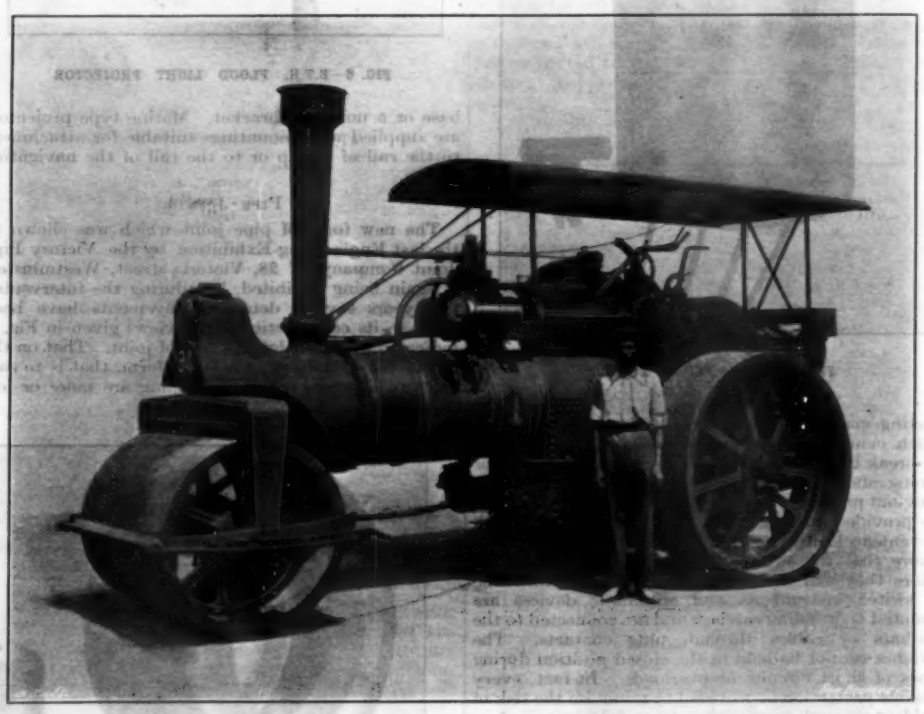
Alloy Welding Processes, Limited, are exhibiting, among other things, a petrol-driven electric arc welding set, which is claimed to be the lightest set at present on the market. Another set, which is shown in Fig. 9 on page 266 has been specially designed to meet the requirements of tramway engineers. Both sets are enclosed by stout steel covers, and can be operated in the open without any other form of covering. The set shown in Fig. 9 on page 266 has a generator, which, by means of a field regulator, can be made to give an output of from 50 to 200 ampères, and the machine controls the output automatically without a resistance or reactance in the circuit. The motor is a 10 horse-power direct-current machine, designed to run at a speed of 1200 revolutions per minute, and is wound to suit any supply circuit. On the generator switch panel, which is of the ironclad pattern, admiralty water-tight moving coil voltmeters and ammeters are fitted, also a shunt regulator, a single-pole knife switch and two Simmonds plugs for the welding leads. The ironclad motor starting panel is provided with a double-pole switch combined with fuses or a single-pole circuit breaker, a motor starter with no-volt and overload releases, and two single-pole Simmons plugs for connecting the set up to the main. With the set a complete welder's equipment is supplied.

Automatic Telephones.

The Relay Automatic Telephone Company is showing its latest model of a 50-line installation completely fitted up and in working order, so that visitors have an opportunity of testing for themselves the advantages claimed for the system both in respect to efficiency and speed. The only movement on the main switchboard is that of the armatures on the relays, which have an almost imperceptible movement whilst the telephones are in operation. Only two wires are needed from the switchboard to each telephone, and all the expense in connection with operators' salaries, &c., is saved. We understand that the Admiralty has adopted the system, and that the British Post Office is at the present moment installing a Relay automatic public service exchange at Fleetwood.

Steam Roller Built in Ceylon.

We reproduce in the accompanying half-tone engraving a photograph of a 10-ton steam roller which has recently been completed in the engineering workshops of the Ceylon Public Works Department to designs prepared by Mr. J. Gray, the mechanical engineer of the department,



TEN-TON STEAM ROLLER BUILT BY NATIVE LABOUR IN CEYLON

who has courteously sent with the illustration the following particulars :—

The main point of note is that, with the exception of the cast steel gearing and cylinder lubricator, the whole machine has been produced in the Colony by Ceylonese labour. Mr. Gray, having a fleet of ninety-five steam rollers—all of well-known British makes—to maintain, had ample experience to guide him in preparing the plans. His aim was to produce a machine that would give very long service under bad conditions with unskilled labour, and to that end all bearing surfaces, joint pins, &c., were made of abnormal size. In order to simplify lubrication, the engine was constructed as a totally enclosed unit, with all working parts copiously supplied with oil. Great care was taken to make the crank case perfectly oil-tight, and to render that task easier, heavy ball bearings were fitted to the crank shaft.

A decided advantage of the detachable unit type of engine is that it can be quickly removed from the boiler and easily transported to headquarters for repairs. The ability to do that is, in a mountainous country where transport of heavy machinery by road and rail is difficult and expensive, a great consideration. Six similar machines are now under construction.

Peace Treaty and Lapsed Patents.

Considerable difficulty has been experienced by some inventors owning patents which lapsed during the war, as regards the rights they possess under the Restoration Rules of the Patent Office and under the Peace Treaty. Their position was by no means clear, but a judicial decision has now been given which will materially assist in explaining it. The action in question was that of Cooksley *v.* Crowthorn Engineering Company, Limited, and another (R.P.C., vol. 38, page 294), the patent in suit relating to morticing machines.

The first point to notice is that the invention lay in the combination of certain features in a morticing machine, such as a particular carrier or slide block, morticing tool, radius arm, driving chain, and certain other elements arranged in a particular manner as specified. The patent was dated 1913 and lapsed in 1917 by reason of the non-payment of the renewal fees. Subsequently the Comptroller accepted the fees and restored the patent, and on the next day he issued a formal order to that effect, the restoration being subject to conditions protecting users between the dates of lapsing and restoration. During this period it seems that a certain firm had manufactured parts of the patented combination, but it had not combined these parts together in the way specified in the claim. After the restoration date this firm assembled machines mainly of parts already in stock at the date of restoration.

The company pleaded, firstly, that the Comptroller's order restoring the patent was invalid, because it did not comply with certain requirements of the Patent Office rules, and in the second place, that the manufacture by it which was alleged to be an infringement was made during the protected time. The case was argued at some length both from the point of view of the Patent Office Rules and also with respect to the Treaty of Peace Act and Order of 1919, which deal with Article 307 of the Versailles Peace Treaty. The learned Judge explained this article of the Peace Treaty and showed that it provided that lapsed patents should revive subject to this, that each of the Powers may impose such conditions in respect of the restoration of the patent as it may deem reasonably necessary for the protection of persons who have manufactured or made use of the subject matter of the patent while the patent was in the condition of lapse. It is therefore left to the discretion or the views of the particular Allied or Associated Power to determine what, if any, conditions it considers necessary for the protection of the persons referred to in the article. Under the article it is not obligatory to impose any conditions of any kind whatever; it is left to the Power in question to determine what, if any, conditions shall be imposed. In the judgment the Court defined how the Orders in Council that had been made gave Article 307 the force of statute.

As regards the Patent Rules, an allegation was made that a restoration order could not be valid unless it contained provisions as to compensation which were not inserted in the Comptroller's order at the time when he made it. This was a point of contention, but the Judge showed how the difficulty was overcome, stating that the present orders for restoration were not made under the Patents and Designs Act, 1907, but that they were made under the Treaty of Peace Act, 1919, carrying out the Treaty of Peace of the same year. In the orders under the Act the Comptroller was given certain powers in connection with the restoration of patents dating back to the coming into force of the Treaty. The substance of the judgment, therefore, on this point was that the ordinary Patent Rules did not apply, that the patent was restored under the Treaty of Peace terms and not under the Patents Acts, and that the restoration was valid. It was also held that the infringement being the manufacture of the combination and not of the separate parts, and being made after the date of the restoration, it was one that should be restrained.

Railway Matters.

THE Indian Railway Board has sanctioned the Bengal-Nagpur Railway Company making a detailed survey for a 5ft. 6in. gauge railway, 65 miles in length, to serve the Talchir coalfield near Cuttack.

IT is announced by the Director of the Australian Institute of Science and Industry that in future all the States, as well as the Commonwealth, will order railway rails and fish-plates to standard specifications.

THERE have recently been issued, stitched together, at the price of 2s., the six reports on railway accidents which occurred during the first half of the present year, and which were inquired into by the Ministry of Transport. One of the accidents was that of January 26th at Abermule, on the Cambrian Railway.

THE arbitration, by a board of five representatives of the companies and five of the men under the independent chairmanship of Mr. W. Carrigan, K.C., which has had under consideration the question of the retention of the eight-hours' day on the Irish railways has completed its inquiry and may be expected shortly to report.

THE acquisition by the North British Railway Company of the undertaking of the Burntisland Harbour Commissioners, referred to in this column in our issue of June 17th, was sanctioned by the North British Railway (Burntisland Harbour Transfer) Order Confirmation Act, which received the Royal Assent before Parliament adjourned.

THE appeal of the Ministry of Transport against the decision of the Railway and Canal Commission in the North British Railway Company's claim will be heard in the Court of Session, Edinburgh, on October 18th. A public meeting, protesting against the action of the Ministry in this matter, was held in the Merchants' Hall, Glasgow, on Wednesday, the 7th instant.

THE new short sea route to the Continent *viâ* Harwich–Zeebrugge, recently inaugurated by the Great Eastern Railway Company, adds yet another to the well-known routes *viâ* Harwich. The service is thrice weekly in each direction—Mondays, Wednesdays and Saturdays outwards, and Tuesdays, Thursdays and Sundays inwards. Leaving London (Liverpool-street) at 8.40 p.m., Zeebrugge is reached in time to catch the 6.10 a.m. connecting train for Bruges, Brussels and beyond; and in the reverse direction leaving Zeebrugge at 11.30 p.m., London is reached at 8.0 a.m.

FURTHER proof of our contention that competition between the railway companies is neither dead nor likely to die is seen in the announcement that the London and North-Western and Great Western Companies are restoring, on October 1st, their respective two-hour expresses between London and Birmingham. These were given two and a-quarter hours as from July 1st. Other accelerations in express trains are likely, and among these is the "Cornish Riviera" of the Great Western, which is to resume its Paddington to Plymouth (North-road) run in 4 h. 7 min.

AT one time the Great Western Railway Company would not permit motor cars to be shipped through the Severn tunnel. As the public was inconvenienced thereby the embargo was withdrawn on condition that the petrol cylinders were emptied. A receipt was given for the quantity taken out, and on its being presented at the station on the other side of the tunnel a similar quantity of petrol was supplied free of charge. Early in the war, owing to a shortage of railway staff, this service had to be stopped and the cars were sent *viâ* Gloucester, but it has now been restored.

SIGNALS with coloured lights—red, yellow and green—are being used successfully in the United States, even in in the open where they have to contend with the sun's rays. Hitherto they have been used in this country only in tunnels and dark places, but their success in the installation just opened on the Liverpool Overhead Railway has led to the Ministry of Transport appointing a departmental Committee to consider their merits. Major Edmonds, of the Ministry, is the chairman, and Mr. P. Tait, also of the Ministry, the secretary. Mr. W. J. Thorrowgood, of the London and South-Western, represents the companies, and Captain B. H. Peter, of the Westinghouse Brake and Saxby Signal Company, the manufacturers. The men have two representatives.

THE Atlantic Coast Line is one of the largest, if not the largest, originators of perishable goods traffic in the United States. The fruit and vegetable traffic carried in 1920 formed 94.33 per cent. of the total tonnage. Of the 22,000 box cars the railway possesses 95 per cent. are felt-lined ventilator cars. The line extends from Florida in the south, through Georgia, South Carolina and North Carolina to Virginia. From November to May it handles the fruit traffic from Florida, and as the season advances the other States bring their supply, so that there is a perishable traffic all the year round. Cotton and tobacco are also important items in the goods traffic. In 1920 the Atlantic Coast Line operated 4890 miles, had a revenue of 74,121,956 dols., and an expenditure of 68,943,732 dols.

THE Ministry of Transport statement as to the receipts and expenditure of the railways during July, issued on the 29th ultimo, shows that for railway working the receipts were £20,701,822 and the expenditure £20,448,884. As an offset against the balance there was a loss on "other businesses" of £142,530. That the coal dispute and general depression in trade had an influence on these figures is shown by a comparison of them with those for July, 1920, when, it must be remembered, neither the passenger fares nor goods rates had received their second increase. In July last the passenger receipts were £11,355,809, as against £12,654,958; the goods receipts were £9,935,638, as compared with £11,553,754. The expenses of collection and delivery were not shown separately in 1920. They amounted then to a total of £1,164,589, as against £112,996 for passenger train traffic and £643,811 for goods, a total of £756,807. Expenditure in July last was £345,078 less than a year ago. There was a decrease of £1,184,319 in traffic expenses—due, no doubt, to the drop of 3s. per week in wages—but an increase of £563,910 in maintenance and renewal of rolling stock.

Notes and Memoranda.

THERE is a description in *Power*, of August 16th, of a device used in America to clear electric conduits of *débris* and obstructions after they have been erected in place. A blank cartridge is put in the fitting, which is screwed on to the end of the conduit, and is fired by a hammer. It is said that 200ft. of conduit can be cleared in this way.

A NEW method of rustproofing, which has been applied especially to small automobile parts, consists in boiling the articles in a solution of hydro-phosphate of iron. An attractive dark grey finish is produced, and this is practically proof against all attacks of rust. The process is stated by the *Chemical Trade Journal* to be more rapid than others, while there is no effect on either the strength or the temper of the metal.

A NEW self-lubricating alloy for high-speed bearings consists of up to 40 per cent. of graphite, with lead, tin and copper. The powdered mixture is moulded under pressure into bushings for bearings, which are baked, and then finished by grinding. The product, resembling bronze in appearance, is so porous that it is said to absorb as much as 2½ per cent. of its weight of oil—making it practicable to apply oil from the outside if necessary.

WRITING in the *Journal* of the British Chamber of Commerce, a traveller in South America says that he chanced to visit a little village on the Pacific Coast, where few people wore shoes and the generality of dwellings were made of mud and palm-thatch; yet an electric bulb swung in every hut, and the bare-footed laundress used an electric iron. The local sawmill was driven by electric power. A cascade on the village stream supplied this force, and indeed offered a surplus sufficient to fill the needs of a town of 100,000 people.

THE *Electrical World*, in a recent issue, reproduced a photograph of a speech-projection equipment constructed by the American Telegraph and Telephone Company. This consists of a tower about 30ft. in height, on the top of which four loud-speaking projectors are mounted. Under the tower is a speaker's platform on which are fixed a number of electrostatic transmitters. About 12ft. above this platform a single speech projector is installed, and this created a record by rendering speech audible at a distance of 3.8 miles. The energy amplification is stated to have been 10^{10}.

THE Germans had, according to the *South African Mining and Engineering Journal*, a great belief in the value of the Muanza district of East Africa as a gold producer, and at the time of the war had pegged out 15,000 claims. But health conditions there are bad, and the persistency of the fly prevents animal transport. There is as yet no Mines Department proper, or staff, but a geologist has been appointed by the Colonial Office to report on the whole position. Coal has been discovered inland from New Lagenburg, but without transport no great developments can be expected. There are indications of coal deposits in Ruvi valley.

IN the course of a paper on mining efficiency, read before the South African Institution of Engineers, Mr. F. C. W. Ingle said every mining engineer is aware that drilling machines were in use less than half the time the miner is underground, whereas actual drilling occupied less than one quarter of the time. A jack hammer will drill on an average 2in. per minute. The average footage drilled per machine shift is 15ft. In actual drilling time this would take 90 min. The balance of the time is lost in the miner getting to and from the stope, dressing and wetting down, rigging up and down, machine repairs, and by insufficiency of drill steel, breakages thereof, and failure of air and water supply.

OBSERVATIONS made at the National Physical Laboratory on some standard slip gauges, of continental make, purchased during the war, show that they are growing at a rate of about 0.000006in. per inch-length per annum. This rate of growth is practically constant for the different length gauges. The most recent measurements in August, 1920, tend to show that the rate of growth of the new set is diminishing appreciably. Such variations of size in this type of gauge are, of course, serious when they are used as standard or reference gauges. Periodic measurements were made on a number of alloy bars prepared in the Metallurgy Department, both before and after heat treatment. Some were found to be practically permanent in size, whilst others changed appreciably with time.

REFERRING to the Leyner type of rock drill, the Miners' Phthisis Commission of South Africa says that they make little dust when the water pressure is high, and the tube fitted in the machine to lead the water into the jumper is in order. If, however, the water supply is cut off, the machine will continue to drill, when the amount of exceedingly fine dust formed is very large. On account of its extremely minute size much of the dust produced is not perceptible to the naked eye, and therefore doubly dangerous. There is another danger in the Leyner drill, every witness who has worked the machine testifying to its "fogging" propensities. This saturating of the already humid atmosphere constitutes a menace to health apart from the dust caused in drilling. The Commission is of opinion that no further installations of machines of this type should be allowed unless great improvement is shown both as regards dust prevention and "fogging."

IN an editorial article on the application of water turbines for high heads, *Power* says that a number of difficulties have been experienced with reaction type wheels on high head installations. It has been found that although such units may develop high efficiencies when first put into operation, the efficiency and power both decrease after the unit has been in operation for a comparatively short time, on account of increased leakage at the runner seats and corrosion of the guide and runner vanes. Maintenance charges and repairs also run considerably higher for the reaction type than for the impulse type. As a result of these conditions there has been a growing tendency for the power companies to prefer the impulse type wheel for high-head installations. It is the opinion of a number of prominent hydraulic engineers experienced in the application of high-head reaction turbines that the difficulties encountered with reaction wheels can be entirely eliminated by proper care in the design and construction of the various details of the unit.

Miscellanea.

BOMBAY proposes to spend approximately two million pounds sterling in the improvement of its sewage disposal.

A NEW set of mining regulations has been issued by the Chinese Government. The regulations are not intended to supersede the 1914 regulations, but will merely supplement and explain them.

WHEN the new Hoskins steel plant has been completed at Kembla, it is expected that as much as 20,000 tons of iron ore will be taken monthly from the company's mines on the west coast of Tasmania.

THE Government of India has sanctioned a grant to the Irrawaddy Petroleum Oil Syndicate, in connection with a prospective licence for the oil-bearing area measuring 2376 acres near Pemhuobin village in Sagu township, in the Minbu district.

A PARTY of American geological and engineering experts is exploring the mining property of the South Manchuria Railway. They will investigate the steel possibilities of the ore deposits, and will also give advice on modern methods in the production of coal.

AT the invitation of the Chinese Government, Dr. J. A. L. Waddell, of Kansas City, Missouri, has arrived in China to become the American member of the Commission of four advisers for examining the designs submitted for the construction of a new bridge across the Yellow River.

SAMPLES of uranium ore from the Luiswichi copper mine, in Belgian Congo, belonging to the Union Minière, are being sent to Brussels for analysis and report. An analysis of the first sample has been made by three Belgian mineralogists at the request of the Union Minière, and, it is added, has given encouraging results.

SOME brickworks which are to be put up at Sepandjang, Dutch East Indies, are to be provided with three sets of machinery, consisting of mills, presses, rolls and automatic cutting apparatus. Each set of these machines is to have a capacity of 4000 bricks per hour, so that a yearly output of about 20 million bricks will be obtained. Two annular kilns are to be built, each of a capacity of 50,000 bricks daily.

IN order to increase the annual output of radium in the country, which at present is only one gramme, the Czecho-Slovak Government has granted twelve million crowns for the technical improvement and enlargement of the mines. The annual output is expected as a result of these developments to reach four grammes, of which 1.2 grammes will be used for educational purposes and 0.8 grammes for medicinal purposes in Czecho-Slovakia itself. The remainder will be lent to foreign countries.

A REPORT just issued by the United States Geological Survey shows that the value of the mineral output of Alaska in 1920 was 23,307,757 dols.; in 1919 it was 19,620,913 dols. The gain in 1920 was due entirely to the increase in the output of copper, which was 47,222,771 lb. in 1919 and 70,435,363 lb. in 1920. Eight Alaskan copper mines were operated in 1920, as against eleven in 1919. The value of the total mineral output of the territory during forty years of mining is 451,474,789 dols.

SOME samples of nickel ores consisting of glance, pyrites and kupfernickel, occurring in the gneiss, slates and quartz rocks of south-eastern Yunnan, China, have been sent to London for assay purposes, but no workings of this metal exist in the region. Certain galenas assayed from the Tungchwan region have been found to contain a small percentage of nickel. Associated with cobalt, the metal seems to exist in ores sent in for examination from the Red River district, to the west of Kochiu, but in none of these regions, according to *Finance and Commerce*, is any mining going on at the present time.

IT is announced from Canada that the largest hydro-electric plant in the Dominion's maritime provinces has just been completed at the works of the Bathurst Lumber Company, at the Nepisquit Falls, in Restigouche County. Work was begun in May, 1919, and the plant has been completed at a cost of 1,750,000 dols. Provision has been made for three generators, and two have been installed, but at present only one, with a capacity of 4500 horse-power, will be used. The Bathurst Lumber Company will require about 2500 horse-power for its own plants; another 1000 horse-power will be used by the Newcastle and Dominion pulp mills, leaving a margin of 1000 for other demands.

A REPORT on the situation of the Swedish iron industry, which was read at a recent meeting of the Ironworks Association at Gothenburg, shows that the export of iron ore during the first seven months of 1921 amounted to 2,500,000 tons, or 600,000 more than during the same period of 1920. The export of different kinds of iron during the same period of 1921 totalled 68,000 tons, as compared with 162,000 tons during the first seven months of 1920. Statistics regarding the activity of furnaces and forges reveal a great depression. For example, only twenty smelting furnaces out of a total of 134 were working at the end of July, as compared with 66 at work at the end of July, 1920. The steel works have only been producing spasmodically, foreign competition, owing to the exchange rates, having created a very difficult situation in the industry.

THE contract for Sections 1 and 2 of the new Welland Canal has been awarded to Mr. J. P. Porter, of Halifax, N.S. These sections comprise the work between Lake Erie and Lake Ontario, a distance of seven miles, and will cost eight million dollars. Tenders for Sections 3 and 4, work upon which has been going on under the cost plus percentage plan, will be called for by the Department of Railways and Canals not later than September 5th. Work on Section 5 is already being done under contract. With the completion of these five sections the new canal, which is to have seven locks instead of twenty-nine used in the present canal, will accommodate vessels of 14ft. draught. When the portion of the canal from the end of Section 5 into Lake Erie has been deepened, vessels of 12,000 tons will be able to pass from Port Arthur, the head of navigation on the Great Lakes, to Kingston, at the foot of Lake Ontario. The length of the Welland Canal is 27 miles and the total distance from Port Arthur to Montreal 1214 miles.

THE SHIPPING AND ENGINEERING EXHIBITION AT OLYMPIA

(*For description see page 262*)

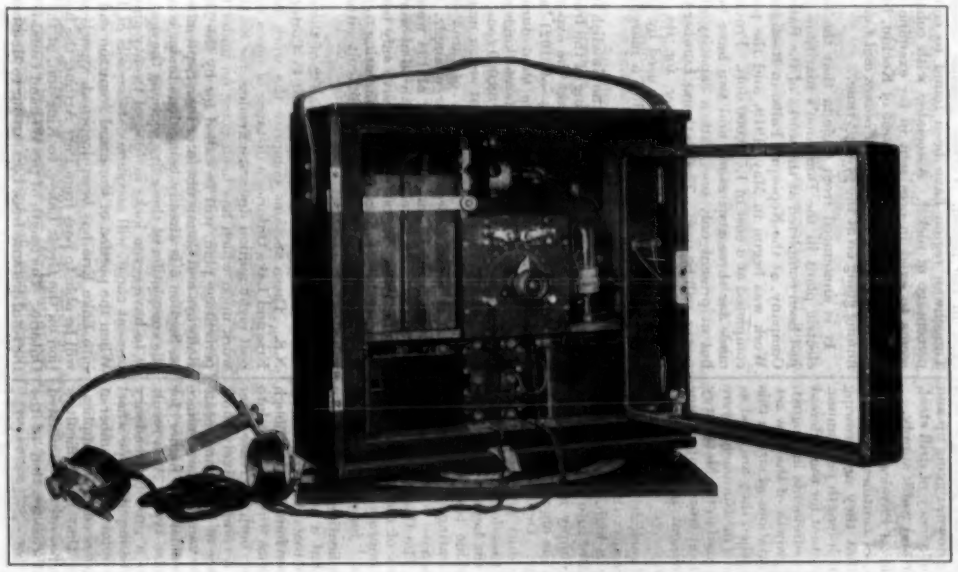


FIG. 8—B.T.H. PORTABLE WIRELESS RECEIVER

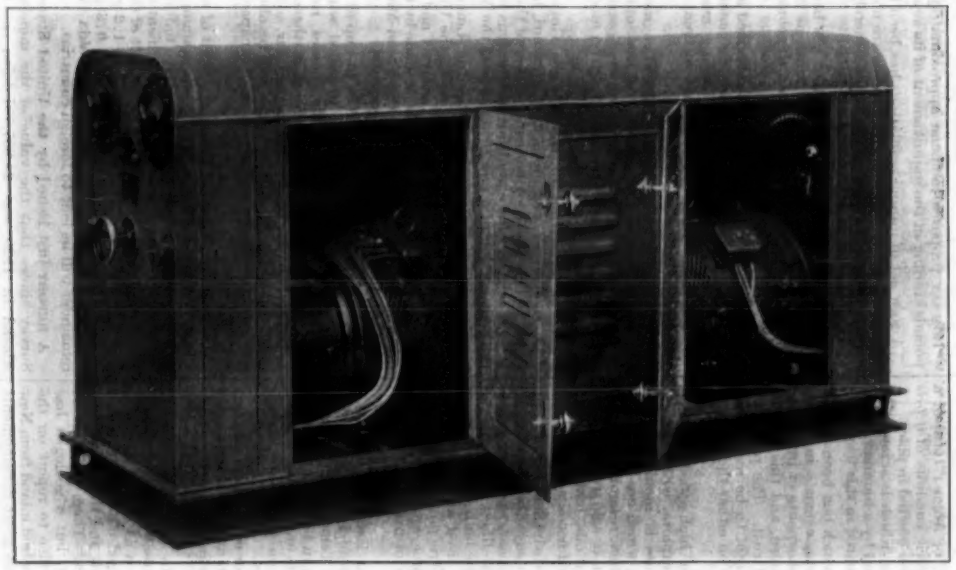


FIG. 9—MOTOR DRIVEN ELECTRIC ARC WELDING SET

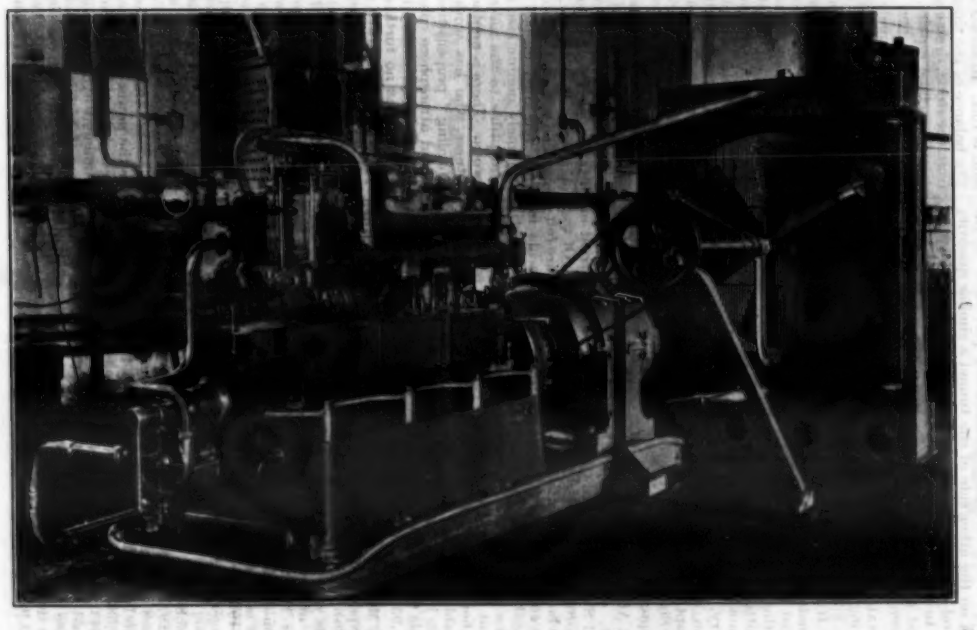


FIG. 10—THORNYCROFT SHIP'S EMERGENCY LIGHTING SET

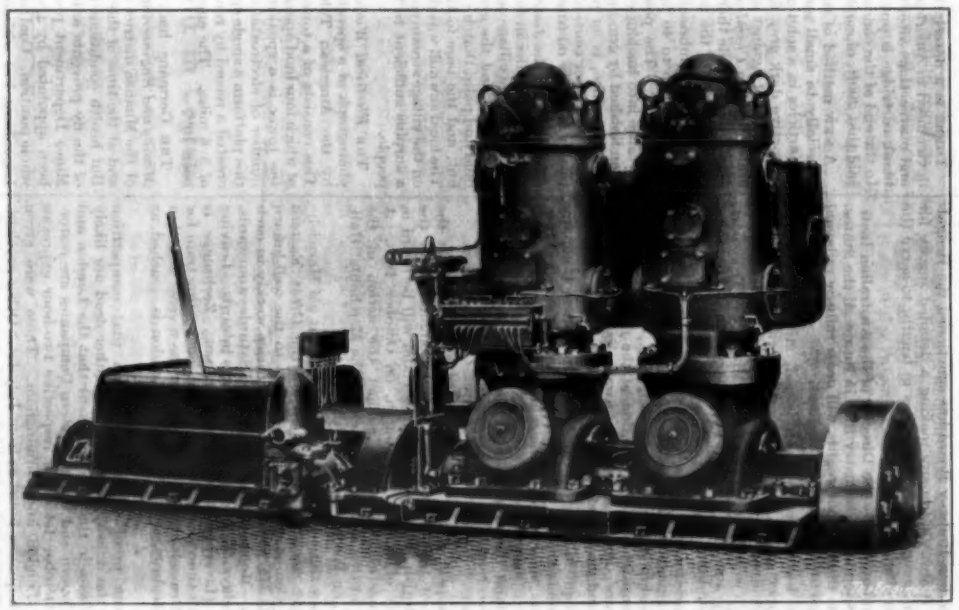


FIG. 11—VICKERS-PETTER 54-B.H.P. HOT BULB ENGINE

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THE ENGINEER.

SEPTEMBER 9, 1921.

Turbo-Electric Propulsion.

THE rumour that one of the four new battle-cruisers of this year's naval programme is to be fitted with a turbo-electric system of propulsion still persists, though it is very difficult to imagine on what grounds it does so. The turbo-electric is a system of transmission for marine purposes that has been received with little favour in this country. Whether because marine engineers are not usually expert electricians—and, if so, it is really mere prejudice—or whether as the result of a careful consideration of its merits compared with those of mechanically geared turbine installations, the fact remains that attempts to introduce it into Great Britain have hitherto signally failed. There is therefore available here very little actual experience on the subject beyond what may be gathered from foreign sources. As a result of comparative trials made on three 12,000-ton colliers fitted respectively with twin screws, driven by reciprocating engines, geared turbines, and turbo-electric machinery, the United States Navy Department fitted electric driving to the battleships of the "New Mexico" and "Tennessee" class, and has adopted it for the new battleships and battle-cruisers now under construction. With these remarkable exceptions, vessels fitted with this type of machinery are very scarce indeed.

The progressive nature of the Admiralty Engineering Department towards all developments which offer promise of success is well known, but it is hardly likely to lead the Department to make its first experimental installation on a scale more than twice that of any British power station. In fact, very few stations in the world contain a plant capable of a steady output of 125,000 kilowatts, which is what the new installations represent. That in the New Mexico was 24,000 kilowatts. The history of United States battleship machinery since their first Dreadnought Delaware was constructed has hardly been consistent. We have seen reciprocating engines, twin-screw direct-connected turbines, four-shaft turbine installations, more four-shaft installations, a reversion to reciprocating engines, then another twin-screw turbine and a reciprocating engine, then partially geared turbines and the electric drive follow one another year by year, and the last step was determined on while the latest battleship was fitted with piston engines. The all-geared installation has not been tried in United States battleships. There is no doubt that the United States Navy Department exhibited extraordinary boldness in passing directly from the "New Mexico" type to battleships of 60,000 and cruisers of 180,000 shaft horse-power. The latter are to be propelled by four shafts and the application of motors of 45,000 horse-power to each will be a very noteworthy feat. In the "New Mexico," the shaft revolutions were brought down to 165 at 21 knots, which enabled very efficient propellers to be adopted. The Hood's revolutions were 210 for 32 knots, and anything much less for transmitting those enormous powers is likely to lead to difficulty in the manufacture of the shafting, the tail shafts for the latter being no less than 28½in. in diameter, so that with electric driving other conditions than the motor affect the speed of rotation. The general claim made for the advantage of electric driving is that (*a*) the turbine speed is independent of the propeller shaft; (*b*) one generator can be run, for low powers, at nearly its full capacity and drive all the motors, the full capacity rendering it more economical than four separate units each running at a quarter of the power which is being developed; and (*c*) there is no astern turbine. It is very difficult to get marine engineers in this country to admit the advantage of any one of these points. With mechanical gearing, the turbine speed can be made almost anything desired, and with turbines driving generators, it is the construction of the generator which often controls the turbine speed. The highest turbine speed which can be used depends on the necessary area through the low-pressure blading for the desired vacua and blade efficiency, in association with the strength of blade and centrifugal stress. It may be necessary to reduce the revolutions when the power is high in order to increase the area for steam to pass through the blades without unduly increasing its velocity. This condition is frequently met with nowadays in destroyers and cruisers, and when a design approaches it there is no more to be gained from the economical point of view by putting up the revolutions. If anything, the geared installation has an advantage in this respect over the electrical drive. The latter must rotate at revolutions which suit the number of cycles employed; the former may run at any odd number. As regards (*b*), owing to the power being so high for the speed, neither turbine has any advantage over the other as regards full power economy, and while one turbine generator, run at nearly full power for, say, quarter-power, will be more economical than four units each run at one-sixteenth, there is no gainsaying that when both generator and motor efficiencies are considered the difference will be materially reduced. As regards point (*c*), that there is no astern turbine, this is merely a small matter. With gearing, no trouble accrues from the small size of astern turbine now fitted. Against these claims there are some formidable disadvantages. First of all, the combined motor and generator efficiency at full power is materially less than that of reduction gearing. Secondly, as the turbines will be practically identical, because they will each be run at practically the maximum revolutions, and piping and condensing plants are similar, we have, in one case, the gear wheel, pinions and casing, and in the other, generator, motors and switchboard and wiring to contend with, and the weight of the latter is obviously far more than that of the former. Thirdly, as regards the astern turbine, the motors and switchboards must contain corresponding complexity to enable reversal to be effected. Summarised, we might say that turbo-electric propulsion in the eyes of British marine engineers offers three salient disadvantages:—(*a*) Lower economy at all except very low powers; (*b*) considerably greater weight; and (*c*) more complexity by the full extent of the whole system of electrical control, the steam element remaining practically as before.

For these reasons in general, without entering into many minor points, it is most unlikely that the Admiralty advisers would commit themselves to an experiment on a colossal scale. We invariably hesitate to criticise a system which is endeavouring to fight its way, and least of all on hearsay evidence. But we admit that prior to being willing to support the Admiralty Engineering Department in an experiment on turbo-electric propulsion on even the scale of a light cruiser, we should like to know a great deal more about the performance of the New Mexico and Tennessee than has hitherto appeared. Experience of small merchant vessels with this class of machinery has been anything but satisfactory in some cases, though a number of vessels in the United States are to be fitted with it. We shall look to the future development of the type with much interest.

Classics and Technology.

A PAPER read by Professor A. Smithells before the Congress of the Universities of the Empire at Oxford on July 6th has received less attention, outside educational circles, than it merits, and we were glad to find a large part of it reprinted in a recent issue of *Nature*. The matter with which Professor Smithells was concerned was the teaching of technology in the great universities. He spoke as one knowing that little sympathy was to be expected from many of his hearers. To them no law was greater than that

the universities should hold aloof from all vocational studies, save, perchance, those pertaining to the Church, Law, and Medicine. Pure science might be tolerated, but applied science would of necessity introduce an industrial atmosphere in which the higher education could not exist. That was the attitude of mind of the universities up to a quarter of a century ago; there are still many who believe that it is the right attitude, and Professor Smithells, himself, went so far as to admit that there were other policies connected with university administration that he would less gladly welcome than the expurgation from technology. But, he said, "the tendency of those who are so susceptible to anything that seems to threaten a depreciation of life to say, 'Let industry have the brains it wants, get them trained how it wants, and where it chooses—*anywhere but here*,' seems to me a fatal closing of the eyes to what is written in blood on the pages of recent history." He then advanced with persuasiveness the plea that the universities should be open to all knowledge, and that it would be shortsighted to debar technologists from the manifest benefits of university life and to deprive the universities of the advantage of having in their midst great technological intellects.

Step by step the universities have been driven back from the position they once held, and *pari passu* with them the public schools, the preparatory schools and the national schools have retreated. If Dickens found a living example for the technological methods of Mr. Squeers, it stood alone and marked the beginnings of a utilitarian system which since then has swept over all kinds and classes of schools. In early Victorian days, very few people ever thought of education as vocational. It never occurred for one moment to the select Academies that they were preparing young gentlemen—and far, far less, young ladies—for any occupation in life by which they would earn their livelihood. To be educated, to know something of the classical authors, to have some acquaintance with at least one foreign language, to be conversant with a few salient facts in the history of the world, and to be instructed in the "use of the globes," was to be genteel; those were the accomplishments of ladies and gentlemen, they were not arts acquired with the object of turning an honest shilling. The change came, perhaps, with the founding, under Prince Albert, of the Science and Art Department. That was essentially a German invention with a close parallel in the Technische Hochschulen, which, up to the time of the war, were held up to us as shining examples. We may sneer, if we will, at the early-Victorian education, but as time goes on we shall see the pendulum swinging back towards it, and find less trust being put in a system of education, which in every kind of school tends, whether it is admitted or not, to become vocational. We shall, we believe and hope, see the day when young men are sent to science colleges, not necessarily because they are going to pursue scientific or technological careers, but because the educational value, the refiningtinfluence of science, will be recognised; and we shall see the day when the ladder which leads from the board school to the university will no longer be mounted in the belief that it is the road to wealth, but will be regarded, as it should be regarded, as the staircase to intellectual delights. We know, let us admit it at once, of nothing harder to the man who has to earn his livelihood than this aspect of education, but it is not so hard that it cannot be grasped, and, unless our whole educational system is to come in fragments about our ears, grasped it must be. We must make haste to get rid of the false view of education which is held out by a hundred advertisements. It is only in the country of the blind that the one-eyed man is king. Where all have full use of both eyes, it is other qualifications that bring kingship. We aim at educating everybody. When that object is attained, the advantage which the educated individual is presumed to possess will disappear. A position of that kind has already been reached. In years gone by a knowledge of the arts of reading and writing and casting up figures was sufficient to secure a clerkship. Nowadays, when all have these simple accomplishments, their vocational value has disappeared. Vocational training is, manifestly, more necessary than it ever was before in every walk of life, but in consequence of its wide expansion it confers no special benefits upon its possessors, and it is to other qualities that they must look for success in life. What those qualities are it is not now our purpose to indicate. Suffice it to say that in the past men found them through a liberal classical education—which never meant, as some seem to believe, no more than the study of dead languages—and there are not lacking reasons for believing that in the future men will find them again in an education of a similar kind.

We recall, once again, the statement by Lord Askwith that labour agitators are made from men who discover too late that a better education than that of their fellow-workmen does not secure for them the positions in life they anticipated. Experience all over the world affirms the truth of that statement. And it will remain true as long as men and women continue to look upon education as of necessity a money-making acquisition. We must seek the time when the working man will want education, not with the object of leaving handicrafts, but with the object of enjoying his leisure in the pursuit of those things which are thrown open to him by the increase of knowledge. Until that time comes, education will continue to have disturbing, even menacing, qualities, and those who contend that the spread of the knowledge of letters has brought more harm than good to the world will continue to find support for their mistaken views.

American Ordnance Production in the Great War.

No. III.*

THE United States Bureau of Ordnance contains within itself a "Special Board on Naval Ordnance," an advisory committee charged with the investigation of new ideas and inventions relating to ordnance material. During the war this Board was, of course, deluged with schemes submitted by private persons whose inventive faculties had been stimulated by the great emergency. As was the case in this country, suggestions of real practical value were few and far between, the majority being quite chimerical. One of the most important proposals brought to the notice of the Board involved a new method of gun construction, submitted by Mr. A. H. Emery and Professor P. L. Bridgeman, the latter of Harvard University. This method was reported upon favourably, and the Bureau made experiments which convinced it that the Emery-Bridgeman process was superior to the shrinkage method. It produces initial tension in the outer layers of the gun, and initial compression in the inner layers by fluid internal pressures of such magnitude as to stretch tangentially all layers, save the outermost, beyond their elastic limit. Technically known as the radial expansion process, it produces the same result that would be obtained by the shrinkage method applied to a gun consisting of an infinite number of infinitely thin tubes. A number of guns have already been manufactured on the new system, which is being further developed.

Since the war the "Special Board" has been working on several problems, including that of a new motive power for torpedoes, with a view to increasing their range and speed. The question of dispersion in salvo firing at long range and the possibility of limiting the "spread" of projectiles is another subject receiving close attention. Flashless powder for the secondary armament, introduced during the war, is undergoing development. The advantages of this powder for night firing are obvious, for it enables fire to be opened without disclosing the position of the ship and eliminates the blinding effect on the ship's own *personnel* which results when ordinary smokeless powder is fired after dark.

Early in the war the Bureau established a section to deal exclusively with aviation ordnance, including bombs, sights, &c. One of the first tasks of this section was to modify the standard Lewis machine gun for use in aeroplanes. The weapon was lightened, air cooling substituted for the water-cooled radiator, and the size of the magazine increased from forty-seven rounds to ninety-seven rounds. Deliveries of the modified type began in January, 1918, and at no period of the war was there any shortage of this weapon. For flexible Lewis gun mounts, the Scarff ring, as originated by the British, was found satisfactory and adopted. The increasing use of aircraft for anti-submarine work revealed the need of a large calibre gun which would be powerful enough to penetrate the hull plating of a submarine. To meet this requirement, the Davis non-recoil gun was mounted in the American flying boats. The principles of this gun are fairly well known. The barrel, open at both ends, is loaded at the centre by rotating half of the barrel round an offset axis. The shell leaves the muzzle in the usual way, while a rear charge of equivalent weight is projected from the rear barrel. As the force of the explosion of the charge is absorbed by the reaction between the projectile and the rear charge, no shock of recoil is transmitted to the mounting. In the first Davis gun a rear charge of bird shot and vaseline was used, but in the improved model a steel cartridge case is expelled from the rear, leaving the bore clear for the next load. Stops are fitted to prevent the rear barrel being depressed sufficiently to endanger the upper wing of the aeroplane. For sighting purposes a Lewis gun is superimposed on the Davis gun barrel at such an angle that the bullets from the former and the shell of the gun will strike the water at the same point when fired from a height of about 1000ft. To aim the gun, bursts are fired from the Lewis gun when approaching the target, and when the bullet splashes are near or on the target the Davis gun is discharged, a double trigger being employed. The introduction of this gun and the possibility that its calibre may increase has undoubtedly made the aeroplane a more formidable opponent to submarines and surface craft alike. A 3in. Davis gun has already been made for use in large airships. Another promising weapon, still in the experimental stage, is a 37 mm. automatic gun firing through the hub of the propeller.

The mass manufacture of bombs for aircraft was begun by the Bureau of Ordnance as soon as the necessary arrangements could be made. Generally speaking, the American type bombs are, or were, similar to the British, a certain standard having been adopted to facilitate the joint operations of British and American bombing machines in the latter part of the war. In October, 1918, contracts were placed for the following heavy-case bombs:—25,000 112-pounders (burster 28 lb. amatol), 10,000 250-pounders (111 lb.), and 5000 550-pounders (180 lb.). Each of these bombs was to be fitted with both a nose and tail fuse and a hanging band for horizontal suspension. A suspension lug was incorporated in the nose fuse to enable the bomb to be suspended vertically inside the fuselage of Handley-Page and Caproni machines. These contracts were withdrawn after the Armistice, but a limited number of each type of bomb was completed for test purposes. The improvement of bomb sights engaged great attention. The first pattern, evolved by Lieut. Boettcher and Captain B. L. Smith, which gave the pilot both a positive and visual indication of the relation between his actual course and the bearing of the target, was ordered in December, 1917. Early in 1918 the attention of the Bureau was drawn to the "course-setting sight," invented by a British officer, Major Wimperis, which made possible effective bombing either with or without drift. In May, 1918, a British officer arrived in Washington with a model of the sight, which lacked only the pilot directing attachment to complete its many excellent features. Within five days this attachment had been fitted and the new sight tried in the air "with astonishingly good results. Re-design of the sight was begun at once by Lieut. Boettcher, and by August production began, adequate numbers of these sights having since been available. Two modifications, one for high-altitude work and one for use in dirigibles, were later made and issued."

Some interesting details of the Lewis gun camera are given. In October, 1917, the best gun camera available was the Hythe pattern, which is described as being somewhat clumsy in construction and able to take only six pictures, one for each pressure on the trigger. In the following year, an entirely new camera was produced by the Eastman Kodak Company, and, with the assistance of the Bureau of Ordnance, this apparatus was further developed. The camera can be fitted to the Lewis gun without any modifications, for it simply takes the place of the magazine and is actuated by the Lewis gun trigger. Standard cinematograph films are employed, and ninety-seven exposures can be made for one loading of the magazine. Photographs are taken automatically as long as the trigger is under pressure and at the same rate as the fire of a Lewis gun. By means of this camera, every stage of a combat in the air can be recorded photographically. Subsequently, a time register device was fitted, which shows on the film the image of a stop-watch hand, and enables the time to be recorded at which the first vital shot in an air duel is fired.

The possibilities of torpedo attack by aircraft have not been neglected by the Bureau. Experiments began in 1914, since when various types of machines have been equipped for the dropping of torpedoes. It was believed at first that the Levering system, by which the torpedo is lowered from a thin cable and automatically released at a predetermined height above the water, promised the best results; but difficulties encountered when the system was tested with a full-sized torpedo led to its temporary abandonment, whereupon the Bureau took up the question of dropping the torpedoes in free flight. No details of recent development in this work are given.

The difficulties we in this country had to contend with in regard to the supply of fire control instruments and optical glass during the war had their counterpart in the United States. As the Bureau observes: "Fire control, as understood in naval services, includes the entire system of directing the operation of the offensive weapons of a vessel, including material, *personnel*, methods and organisation. Its proper development and use is a factor of greatest vital importance to a ship or fleet. When two or more ships are in action, both will ordinarily be under way and constantly changing course, speed or both. The problem, then, is for the ship to obtain and constantly keep the correct range of the enemy vessel, and it is the duty of the fire-control section to provide instruments for finding the range, for automatically tracking the enemy, for transmitting such information by electrical means throughout the ship and to provide the telescopes at the guns."

Although the Bureau does not say so expressly,

* No. II. appeared September 2nd.

it is known that the system of fire control now used by the American Navy is indebted for certain important features to British pioneer work in this direction. In October, 1918, the Fire-control Section was taken over by Commander W. R. Furlong, U.S.N., who had previously served with the Grand Fleet. During the war period a very large quantity of fire-control material was ordered by the Bureau, *e.g.*, battle tracers, directorscopes, range keepers, plotting boards, range and deflection receivers and transmitters, rate of change of range projectors, target bearing transmitters, time of flight clocks, bearing indicators, &c. Between April 6th, 1917, and November 11th, 1918, the number of range-finders in service increased 67 per cent., gun-sight telescopes 95 per cent., and fire-control binoculars 325 per cent. This represents a creditable achievement, considering that America, prior to 1917, was wholly dependent on foreign sources, chiefly German, for supplies of optical glass, and before the war had been accustomed to import considerable quantities of optical parts, such as lenses and prisms, for instruments of high precision. With foreign supplies no longer available and in view of the suddenly increased demand, it was decided to establish a small optical glass plant, whose main function would be to develop processes for the benefit of the industry at large. Within a few months, glass of high quality was being delivered at the rate of more than a ton per month. By rapid stages the plant was much enlarged, private firms took up the new manufacturing processes, and production on a scale ample to meet all needs was soon in full swing. "In this connection," says the Bureau, "it is interesting to note that, in general, the manufacture of optical glass has not been an attractive commercial activity, due to the technical difficulties encountered, the limited demands in peace time, and to the fact that the great German factory, the Jena Glass Works, of Schott und Genossen is directly under the patronage of the Prussian Government, and so subsidised as to be able to undersell all competition."

Actual war experience was needed to convince naval men that director fire, *i.e.*, firing all guns from one station, was incomparably superior to the system of laying each gun separately. Reports from abroad early in 1916 drew the Bureau's attention to the necessity of maintaining the sight-bar range by means other than spotting, especially as smoke screens were coming into use in action. As existing range clocks were found unsuitable for this purpose, the Ford range keeper was brought out by Mr. Hannibal C. Ford, adopted by the Bureau, and systematically improved, "so that to-day this instrument is considered to be superior to the similar instruments of any of the foreign navies." The "follow the training pointer" system was also developed, the target-bearing system in use before the war being amplified to include a target turret system, which transmits to the turret the relative bearing of the target, corrected for deflection, and thus enables the turrets to engage an invisible target simply by following the pointer actuated from a distant control station. The success attending this device prompted its development for elevation. A drawback to the training pointer system was the synchronisation of the step-by-step motors. Consequently, when the adaptation of the pointer system to elevation was under discussion, it was determined to employ synchronous motors. The design, when worked out, was entrusted to Mr. Hannibal Ford for manufacture. In May, 1918, the first unit, the range converter, was tested and modified, and by the following September the first complete synchronous "follow-the-pointer" elevation was fitted in the battleship New Mexico. All the principal ships of the U.S. Navy are now being fitted with this so-called "Bureau-Ford" system. For broadside guns of the secondary armament the training pointer system in train and elevation, as introduced by the British Admiralty, has been adopted for the American Navy. Summarising its activities in this particular sphere, the Bureau writes: "It can truthfully be said that the magnitude of the fire-control problem in its various phases—mechanical, electrical and optical—has increased enormously, both as regards design and production, and it is the earnest hope and expectation of the Bureau that it may be able to keep fully abreast of all developments in this difficult field, and, indeed, serve as a pioneer in the solution of fire-control problems for the Navy."

Apart from the methods employed to accelerate production, but little information is given as to the technical development of torpedoes. At the opening of the war there was a serious shortage of these weapons. A total of 1040 was distributed among the vessels of the Fleet, and 1056 more were held in reserve, there being thus an aggregate of 2096 torpedoes ready for use. On order, but not delivered, were 2806 more. A short time previously the manufacture of torpedoes had been undertaken at the Naval Gun Factory, Washington, but the output from this source was strictly limited. The central torpedo station was at Newport, Rhode Island, where torpedoes are overhauled, repaired and issued. The torpedo range at Narragansett Bay is about four miles north of this station. When war was declared, the Newport station, in conjunction with the E. W. Bliss Company—which manufactures the major proportion of the American Navy's torpedoes—was designing a 21in. torpedo for use in submarines. On April 1st, 1917, only twenty torpedoes were approaching completion at the Bliss works. In order to hasten production the Navy Department made an arrangement with the company, providing for the extension of the latter's manufacturing space by 40 per cent. It was hoped in this way to bring the output up to at least 300 torpedoes a month. This figure, however, was never attained; delays arose in connection with the delivery of air flask forgings, and the maximum output per month did not exceed 150 torpedoes. The position had therefore become serious, but it gave the Navy Department an opportunity of putting into effect a long-cherished scheme, viz., the erection of a Government torpedo assembly plant and the "farming out" to reliable manufacturers of the various parts and units of torpedoes. In August, 1918, it was decided to build this plant at Alexandria, Va. The Armistice was not allowed to interefere with the work, which has since been completed. Near at hand, in Chesapeake Bay, a 20,000-yard torpedo range has been laid out. In November, 1917, a torpedo repair station was established at Queenstown, Ireland, to take care of the torpedo material of the American vessels co-operating with the British naval forces. Some months later the Paravane Shed at Haulbowline was turned over to the Americans by the Admiralty, and with the aid of a Diesel engine, power plant and air compressors brought from Newport, R.I., the station was made entirely self-supporting. Later on, this building was enlarged at the joint expense of the Americans and the British. Down to the Armistice it had completely overhauled 520 torpedoes. When hostilities ended the plant was packed up and returned to the United States. Torpedo tubes and air compressors had to be ordered in very large numbers to meet the sudden expansion of the United States destroyer programme. Deliveries were very satisfactory on the whole, and it does not appear that the completion of any boat was delayed by the non-delivery of its torpedo armament. In contrast to the reciprocating-engine type used by practically every other navy, the American torpedo is propelled by balanced turbines. "The advantage of the United States Navy type over the other," says the Bureau, "is in its inherent quality of constant speed and very smooth running, which prolongs the life of the torpedo. The advantage of the reciprocating-engine type is in that it lends itself to different speeds and is perhaps a little better developed, so that it is more reliable than ours, though not as efficient. Since the summer of 1918, when the demand for increased range became apparent, the Bureau, in connection with the Naval Gun Factory, completed the design of three new torpedoes, which are already in process of manufacture. Two of these torpedoes will have a range in excess of any torpedoes now known to exist, while the third will be capable of a range at a speed greater than any yet realised."*

Space does not permit us to refer at length to the interesting section on turrets. We learn that the Navy Department's decision to change the guns of the battle-cruisers from 14in. to 16in. was made on the strong recommendations of the Bureau of Ordnance. The two models fire projectiles weighing respectively 1400 lb. and 2100 lb., the muzzle velocity being in both cases 2800 foot-seconds. In action the battle-cruisers will throw a weight of metal of 16,800 lb., or about 8½ short tons per broadside. "With their speed of 33 knots these ships should by far surpass all other similar ships of foreign navies." In view of the lessons taught at Jutland, the anti-flash arrangements in American ships were improved to minimise the danger of flare-backs, &c., in action.

Owing to the comparatively short time they were in service before the Armistice, little was heard of the work done on the Western Front by the American naval railway batteries. These guns, nevertheless, proved invaluable, and played no inconsiderable part in the final discomfiture of the Germans. They were pieces in reserve for ships in commission and under construction, and not being needed at sea immediately, it was wisely decided to turn them to military use. The leading particulars of the guns were: 14in. 50-calibre model, length nearly 60ft., weight 90 tons, projectile 1400 lb., with a burster of 88 lb. of high explosive; muzzle velocity 2800 foot-seconds, giving a maximum range, at 43 deg. of elevation, of over 25 miles. Complete plans and specifications for the proposed railway mountings were prepared in two months. It is of interest to learn that a British artillery officer, Major-General John Headlam, was "of great assistance in outlining the project and in drawing up the general requirements which a heavy railway mount must fulfil." Each of the five battery units comprised the following: (*a*) One gun car, consisting of two large main girders, each 72ft. long, braced and tied together to form a single girder unit with a large centre well in which the 14in. 50-calibre gun, with its slide, deck lugs, elevating gear, &c., was mounted. The gun was arranged to fire from the rails at angles of elevation up to 15 deg. For firing at elevations from 15 deg. to 43 deg., a foundation composed principally of ordinary structural steel girders and timbers was provided. (*b*) One locomotive; (*c*) two ammunition cars; (*d*) one construction gondola car, one construction flat car with crane, and one sand-and-log closed car for carrying foundation material and installing it; (*e*) one workshop car; (*f*) one fuel car; (*g*) three berthing cars and one kitchen car for housing operating *personnel*; (*h*) one battery headquarters car for operating offices, housing officers, &c. Five complete batteries as above were ordered, and provision was made, in addition, for a staff train, including a travelling machine shop and a spare parts car. A very complete and lucid account is given by the Bureau of the gun mounting, how the complete batteries were manufactured in record time—the first being delivered in seventy-two days after the award of the contract—how the ponderous material was shipped to France, and how it was speedily erected there in spite of the mysterious loss, *en route*, of the blue prints. Moreover, by some mishap "the packages marked 'rivets,' on being opened, were found to contain stove bolts, and it was necessary to 'borrow' rivets from all over France. As the only rivets available were metric-sized, the cars were put together with them. On some of the sizes for which no metric-sized rivets were available it was necessary to draw large rivets down to the proper size by hand. In spite of these difficulties, however, the erection of the cars was not delayed."

The first gun girder was unloaded from the ship and put into the erecting shop on July 30th, 1918. On August 11th, the completed gun car and the first train were ready to leave for the front on orders from the French High Command. The guns subsequently traversed nearly every famous battlefield of the war, alternately operating with the Americans and the French. At its trials the first gun was assigned a target about 18 miles distant. Four rounds were fired, all landing within a stone's throw of each other. Elated with the result, the French general went to the American officer commanding and said: "Waste no more ammunition, but go and fire it against the Germans!" It went, and for the next thirty days kept the German railway yards at Laon under continuous long-range bombardment. After the German evacuation of Laon the effects of the 14in. shells could be studied, a task rendered easy by the enormous craters they had made. Other German focal points brought under fire were Tergnier, Besny-et-Loisy—where an ammunition dump was blown up at the thirty-second round—Mortiers, Montmedy, Longuyon and other junctions on the Sedan-Metz railway. So effective was the fire against this last-named vitally important line that many places were found where the railway tracks had been completely severed for a distance of from 40ft. to 70ft.—the diameter of a 14in. shell crater. "It was reported, in addition to the fire in the yards . . . that a troop train in motion carrying many Germans had been hit and completely demolished." The last shot from the United States railway batteries was fired at 10 h. 57 min. 30 sec. a.m. on November 11th, 1918. This permitted the shell to land in the German lines a few seconds before 11 o'clock—when the Armistice came into effect. These guns had the longest range of any artillery employed on the Allied side during the war. An improved type of railway mounting for 14in. naval guns was in process of manufacture when the Armistice intervened. This enabled the gun to be fired at all elevations to a maximum of 43 deg. direct from the rails. A number of these mountings—officially designated "Railway Gun Car Mk. II."—have since been completed, and now form an important branch of the American system of coast defence. As explained, the guns so mounted fire direct from the rails, and it is only necessary to provide a curved track to give them an all-round arc of fire. "Any of these railway mounts can be moved from one coast to the other on very short notice. On almost instant demand, a locomotive can be coupled to them, ammunition cars and all material needed for operation coupled on behind, and the entire outfit can start for the opposite coast within a few hours. They can make the trans-continental trip at a speed of 25 to 30 miles an hour, and arrive at their destination within a week's time."

* It would be interesting to know whether these new American torpedoes surpass the 1914 German 23.6in. model, which carries a charge of 551 lb., weighs complete 2.16 tons, and possesses a range at a speed of 28 knots of about 14,200 yards.

Obituary.

ALICK SARGEANT HILL.

WE regret to have to record the death, on the 31st ult., of Mr. A. S. Hill, chairman and managing director of the Coventry Chain Company, Limited. Mr. Hill was born fifty-four years ago. He served his apprenticeship with the Coventry Machinists' Company, and having completed his training, was appointed manager of the firm's branch at Boston, U.S.A. In 1895 he decided to return to England and take up the manufacture of bicycle and similar chains. His first workshop was an old dye shed in Dale-street, Coventry, said to be identical with that in which the Dunlop pneumatic tire first saw the light. The first produc-

tion from this "factory," a 1in. pitch block chain, which broke on its trial run, was made in April, 1896. Under Mr. Hill's keen management and insight many early difficulties were surmounted. The old dye house was enlarged and equipped with modern chain-producing machinery, until, in 1907, further extension being required, the factory at Spon End was built and equipped. That factory has been repeatedly extended until it now covers an area of over 27,000 square yards and affords employment in normal times for about 2000 workpeople. Mr. Hill was held in very high esteem not only as an employer but in public life. He was elected to the City Council in 1902, and in 1916, following the precedent set by his father and grandfather, became Mayor of Coventry. His period of office coincided with the darkest days of the war, and with labour disputes at home. Into the settlement of these latter—particularly the "Shop Stewards'" dispute of 1917 and the "Embargo" strike of July, 1918—Mr. Hill threw all his energies, and, in addition, sought to do all that lay in his power to help in the production of munitions. His friends believe that his comparatively early death is to be attributed in part at least to his strenuous exertions made during the war for his country's and city's good.

CHARLES I. R. CAMPBELL.

MR. CHARLES I. R. CAMPBELL, O.B.E., who lost his life in the disaster to R 38, was by general consent the greatest authority outside Germany on everything appertaining to lighter-than-air craft. He was born in 1878, and joined the Royal Naval Engineering College, Keyham, as an engineering student in 1894. He was one of three men of his entry who were selected to take the higher professional course in marine engineering at the Royal Naval College, Greenwich. He studied there for three years under such well-known men as Professors W. Burnside, S. Dunkerley and Vivian B. Lewes, and obtained the Admiralty's Professional Certificate in Marine Engineering. He had, however, decided that his bent lay in the direction of naval construction rather than marine engineering, and accordingly changed over to the sister profession and spent a fourth year at Greenwich, in which he took the senior course in naval architecture and passed the required standard. He thus achieved the very unusual distinction of possessing the Professional Certificates required by the Admiralty in both these branches of the technical services. On passing out of Greenwich in 1903, he was appointed Assistant Constructor in the Royal Corps of Naval Constructors.

After a short time at the dockyards he was appointed to the staff of the Director of Naval Construction at the Admiralty, and for a period was engaged chiefly on the design of submarines. In 1909 he was appointed Admiralty overseer of submarines being built at Barrow, removing to Newcastle in 1913 as Admiralty overseer for H.M.S. Malaya and the submarines being built by Armstrong, Whitworth and Co. Shortly after the outbreak of war he was sent to the United States and Canada as one of the Admiralty's representatives in connection with the supervision of the construction of "H" class submarines and motor launches being built for this country. On his return from the United States he was appointed in October, 1915, to take charge of the airship design and construction department, which it had been decided to place under the Director of Naval Construction. It is in connection with this work that he will always be best remembered.

There were at that time six airships in course of construction or on order. In connection with the last two of the series he was able to suggest and embody some improvements which resulted in those vessels marking a considerable advance over the earlier examples of the class, notwithstanding the fact that he had by no means a free hand, orders for material having been placed, and many parts made. He also superintended the design of R 31 and R 32, two wood-framed vessels, built by Short Bros.

Designs for larger rigid airships of the "R 33" class were in progress at the Admiralty when the German Zeppelins were brought down in Essex and elsewhere while raiding this country. Improvements were at once made in the designs of the "R 33" class as the result of the valuable information obtained from a thorough detailed examination of the wrecked enemy airships. While Mr. Campbell was quick to take full advantage of German experience, R 33 and R 34 were by no means copies of L 33, as is sometimes stated to be the case, and it must always be a tribute to Mr. Campbell's sagacity as a designer that when a more modern German Zeppelin was subsequently brought down, she was found to embody several important modifications which he had correctly conjectured would lead to considerable improvements on the L 33 design, and which had already been included in the Admiralty design.

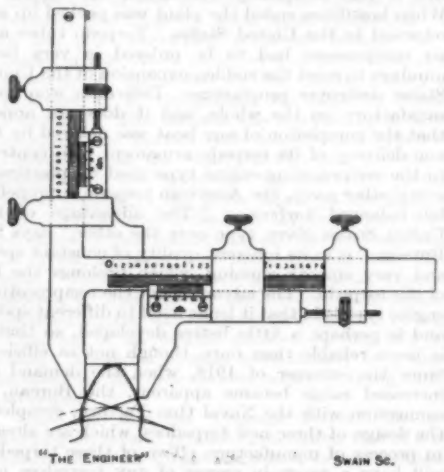
The re-organisation of the Admiralty in 1917 involved the transfer of responsibility for airship construction from the Director of Naval Construction to the Deputy Controller of Armament Production, but Mr. Campbell and his assistants were retained in immediate charge of the technical and design work. Responsibility was transferred to the Air Ministry in 1919, and the change involved in 1920 the definite severance of Mr. Campbell's connection with the Admiralty, but he remained an honorary member of the Royal Corps of Naval Constructors. When Messrs. Short's works at Bedford were taken over by the Air Ministry he was appointed Superintendent of the Royal Airship Works.

F. WARREN.

MR. F. WARREN, another victim of the airship disaster, had, like Mr. C. I. R. Campbell, been an Admiralty official. He entered Devonport Dockyard in 1892, and distinguished himself in the Dockyard Technical School. He joined the Admiralty as a draughtsman on the staff of the Engineer-in-Chief of the Navy in 1903, and was connected with the engine work of airships from the time the Admiralty assumed responsibility for airship design. When the work was transferred to the Air Ministry, Mr. Warren was appointed an assistant airship constructor. He was an authority on all matters connected with high-power internal combustion engines for submarines as well as for airships.

Measuring Involute Gear Teeth.

THE gear tooth calipers illustrated herewith have been designed and are being placed on the market by Messrs. Bostock and Bramley, power transmission engineers, of Netherton, Huddersfield. Unlike similar instruments of American origin, these calipers are made with cast steel bodies and are not built up of plates, while the graduation marks are engraved instead of being etched. The design consists simply of two anvils moving at right angles to

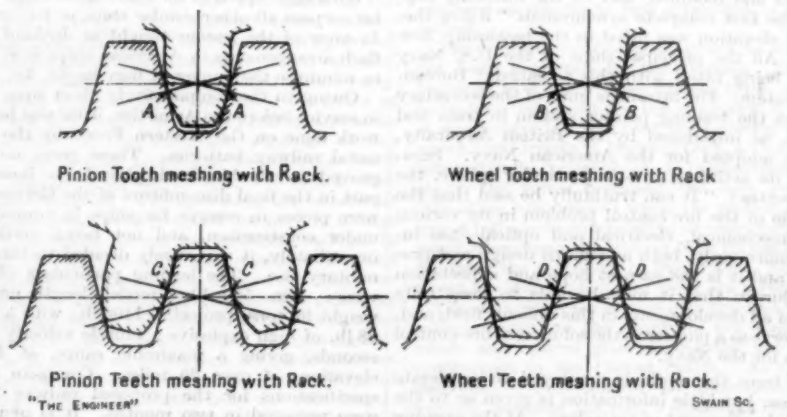


"THE ENGINEER" SWAIN Sc.

GEAR TOOTH CALIPERS

each other, each anvil being provided with a vernier scale attachment enabling the height or thickness of the tooth to be measured to the thousandth part of an inch. The height measured is, strictly speaking, the distance downward from the top of the tooth.

In measuring gear teeth, it is customary to determine by means of suitable calipers the straight line distance between the two points at which the profiles of one tooth cut the pitch circle. This distance, even neglecting working clearance, is not equal to half the pitch of the teeth, because the pitch is an arc of a circle, and not a straight line. The pitch can, however, be deduced from the straight line measurement by reference to a series of tables wherein the two dimensions are correlated with respect to the pitch diameter and the number of teeth in the gear wheel. The use of these tables, if the teeth are of involute form, is, Messrs. Bostock and Bramley argue, quite unnecessary, although very generally adopted. The second engraving illustrates a new system of measuring involute gear teeth originated by Mr. F. J. Bostock. This system depends upon the facts that the line of action in involute gear wheels is a straight line and that all such gear wheels of a given pitch, no matter what may be their diameter, mesh correctly with the corresponding rack, which rack being on the involute system, has straight sided flanks.



NEW SYSTEM OF MEASURING INVOLUTE GEAR TEETH

The upper views in the second engraving represent respectively an involute pinion tooth, and an involute wheel tooth placed centrally between two teeth of the corresponding rack. Contact is made at the points A A and B B, at which the lines of action intersect the rack profiles. Conversely, if a tooth space be placed over a rack tooth, as shown in the two lower views, contact is again made at the points C C and D D, at which the lines of action cut the rack profiles. In spite of the fact that the diameters and therefore the number of teeth of the pinion and wheel are far from being the same, the pairs of points A A, B B, C C and D D are, by virtue of the pitch being the same, all at the same distance apart, and, moreover are all equidistant from the pitch line. Mr. Bostock's system of measuring involute gear wheel teeth, therefore, consists of applying the calipers, as shown in the first engraving, to measure the distance apart of the points of intersection of the two lines of action with the flanks.

For uncorrected gear wheels with standard teeth, in which the working depth is equal to 0.6366 × circular pitch, the thickness and height settings are as follows:—

Pressure angle, 14½ deg.—	
Thickness setting	= 0.4686 × circular pitch
Height setting	= 0.2577 × circular pitch
Pressure angle, 20 deg.—	
Thickness setting	= 0.4415 × circular pitch
Height setting	= 0.2380 × circular pitch

For uncorrected stub toothed gear wheels, having a working depth of 0.5π × circular pitch, the settings are as follows:—

Pressure angle, 14½ deg.—	
Thickness setting	= 0.4686 circular pitch
Height setting	= 0.2194 circular pitch
Pressure angle, 20 deg.—	
Thickness setting	= 0.4415 circular pitch
Height setting	= 0.1965 circular pitch

Corresponding formulæ are available for wheels with corrected teeth. In all cases, it will be understood, the "height setting" is the distance of the intersection points A A, &c., below the top of the tooth, and not their distance from the pitch circle.

The Upper and Nether Millstones.

IN the course of his speech to the shareholders at the eleventh annual general meeting of Petters Limited, Yeovil, Mr. E. W. Petter, the chairman, made the following remarks:—

This is the twentieth occasion on which the directors of this business have met the shareholders—for nine years as a private company, and for the past eleven years as a public company. During the whole of that period we have earned sufficient profits to pay regular dividends to our preference and ordinary shareholders, and place substantial amounts to reserve, for the consolidation and the security of the business. I need not tell you with how much regret the directors have had to send you on this occasion a statement of accounts which, for the first time, shows a loss.

In order that you may thoroughly understand the situation, I must go back to the position in which the war left us. We had three factories with a manufacturing capacity enormously in excess of our pre-war establishment. The directors naturally, and I think rightly, endeavoured to keep these works occupied after the war with peace products.

In 1919 we had an aircraft contract, which, if we had been allowed to carry it out, would have enabled the aircraft works to tide over the transition period; but unfortunately for us, that contract, when about one-third completed, was cancelled by the Government, and the works left without orders. We already had been taking steps to find a new industry to replace the aircraft industry, but, as stated in my speech last year, that effort was frustrated by the refusal on the part of the trade unions concerned to accept any system of payment by results under which alone that industry could have been successfully carried on. Our efforts to engage in the industry of civil aviation have so far proved equally unsuccessful, not because we are not able to produce satisfactory aeroplanes, but because civil aviation as a new industry has not proved able to thrive without Government assistance, and no such assistance has been forthcoming in our case. The directors very carefully considered, in view of these circumstances, whether they should abandon the construction of aircraft altogether; but taking into consideration the great reputation which these works obtained during the war, and subsequently, they felt that it would be unwise to withdraw from that industry, which withdrawal, in itself, would involve heavy capital loss. They

decided therefore to maintain the works and nucleus staff, being fully aware of the fact that in doing so they would incur considerable temporary loss, which, however, they had hoped would be made good on the engine business, and ultimately lead to the profitable employment of the aircraft works. The result has been justified to this extent—that during the current year we are engaged upon an aircraft contract, which at present is in course of execution, and which we hope will, at any rate, relieve the company from loss under this heading during the present year. It requires only a small amount of work to keep our reduced aircraft factory employed; and we feel that there is an obligation on the part of the Government to provide us with a sufficiency of work to enable us to maintain our valuable staff, so that it may be ready to be called upon if, and when, need arises.

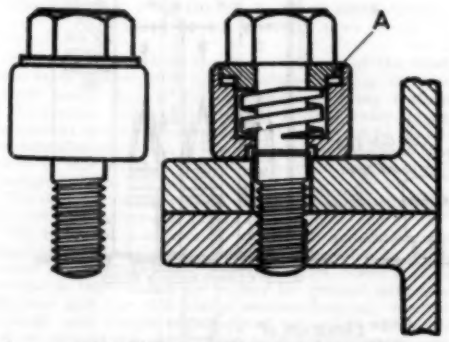
Faced as we were with these large works, and with the occupation for them suddenly withdrawn, we had to consider what steps to take in the best interests of the business. There was at the time a world-wide demand for our engines, which appeared to be capable of almost unlimited development, and, after most careful deliberation from all points of view, we decided to extend our manufacturing facilities, to remove our engine manufacture from the Nautilus Works and concentrate at Westland.

The effect of these alterations has been to leave our old works unoccupied, and although it is a serious thing for the company to have a large factory, such as the Nautilus Works, unemployed, the saving in expenses in getting the whole organisation under one roof fully justifies the decision of the directors in this respect.

The disappointing results of the year's trading are not in any respect due to any lack of energy on the part of the directors or staff to secure sales for the company's products. We have left no stone unturned to secure business for the company. Unfortunately, the unprecedented slump in the engineering trade at home, and particularly abroad, has seriously affected us. One of the greatest difficulties with which we have had to contend in securing orders for our factory has been the high rate of wages which obtained during the whole of the year under review. It is not only the rate of wages, but the restrictions which have been introduced by trades unions which have increased, almost more than the wages, our cost of production. These restrictions relate to the employment of apprentices, labourers and what are known as semi-skilled men. The effect of this, combined with the short hours of working, is such that parts of engines which cost us only a few pence to produce before the war, cost to-day as many shillings. The result has been that we have frequently found ourselves unable to meet competition with the products of other countries or to secure orders at prices which left us a reasonable margin of profit. This applies particularly to export trade. The difficulty with which we are faced is that the regulations relating to employment in most instances are based upon national agreements. My own opinion is, and I believe it is shared by my co-directors, that if we could talk to our men, and put before them the facts relating to this industry, we could arrive at a settlement of these difficulties in a manner satisfactory to themselves and ourselves. But matters of vital importance to them and to us are settled at conferences in London, at which neither they nor we have the opportunity of explaining local conditions, and as a result, both parties are bound hand and foot, and we are unable to extricate ourselves from a position which is equally bad for both parties. This difficulty will have to be met if industries of this character, carried on in districts such as this, are to regain their former prosperity.

Explosion Proof Switchgear.

IN the past the practice of enclosing the current-carrying parts of mining switchgear in cases which will withstand internal explosion has been resorted to, but this naturally makes the gear somewhat unwieldy and difficult to handle, and involves fairly heavy capital cost. Bad short circuits may also set up pressures that are sufficient to burst the cases. The operation of most electrical gear, and certainly all switchgear, involves the



SAFETY JOINT FOR SWITCH BOXES

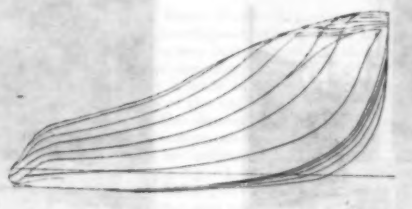
making and breaking of the circuit and consequent sparking at the contacts, and in the event of an explosion occurring inside an enclosure containing electrical apparatus it is essential to prevent the gases being ignited outside. If no provision is made for the relief of the pressure the force of the explosion may rupture the enclosure and ignite inflammable gas in the vicinity, or the same effect may be produced by flames passing through joints or openings in the case. If an ordinary valve is fitted to relieve the pressure inside the case a spurt of flame may issue from the valve and thus cause an explosion in the mine.

These are the conclusions that have been arrived at by the Electrical Apparatus Company, of Vauxhall Works, South Lambeth-road, and in order to overcome the trouble, the relief bolt shown in the accompanying drawing has been devised. The bolt has a spring washer which is enclosed in a dustproof casing, and when the bolt is screwed down the spring is put under compression. The casing is kept in position by a ring let into a groove in the bolt, so that the relief bolt forms a self-contained unit which cannot be taken to pieces but which is used just like an ordinary bolt. When, for example, the bolt is used for holding down a switchbox cover it is screwed up and the spring is compressed until the lip A is flush with the cap. In this position about $^1/_{32}$ of an inch more compression is possible, so that in the event of an internal explosion occurring the cover is allowed to lift slightly and so relieve the pressure inside by allowing the products of the explosion to escape between the flanges of the box and the cover.

The cover therefore acts as a very large relief valve, and the flames or hot gases which escape through the narrow space between the broad cold flanges of the box and cover are cooled to a sufficient extent to prevent the ignition of any inflammable gases which may be present in the mine. We understand that the system has been tested by filling a box fitted with these relief bolts with the most explosive mixture which can be met with in a fiery mine and by placing the box in a chamber filled with a gas mixture of the most readily inflammable kind. The gas inside the box was exploded by means of an electric spark without causing any damage to the box or bolts and without igniting the inflammable gas outside.

GALLOWAYS' UNIFLOW ENGINE.

IN the description of the 200 horse-power uniflow engine made by Galloways, Limited, which we published in THE ENGINEER of August 26th last, reference was made to the delicacy and sensitiveness with which the cut-off is controlled over a wide range through the medium of the special hydraulic valve gear designed by Mr. Pilling. To demonstrate this point the makers of the engine took some indicator diagrams while the position of the governor sleeve was being varied by hand and with the indicator pencil kept continuously on the paper. We publish one of these diagrams herewith; it will be observed that the cut-off varies from almost nil to about 50 per cent. of the stroke.



The Motor Vessel British Industry.

ACCORDING to present plans a specially designed exhibition ship, to be named British Industry, will sail from the Thames in the summer of 1923 for the chief ports of the world. She will proceed first to the West Coast of South America, where there will be four ports of call, viz., Bahia, Rio de Janeiro, Monte Video, and Buenos Aires, and will then sail to South Africa, calling at Cape Town and Durban, and thence to Australia, where the ports of call will be Fremantle, Adelaide, Hobart, Sydney, and Brisbane. After proceeding to New Zealand and calling at Wellington, Lyttleton, and Auckland, the ship will visit Fiji, Yokohama, Kobe, Shanghai, and Hong Kong. Seven days are allowed for docking and repairs at Hong Kong, and on the 358th day after leaving London the ship is timed to start on her homeward voyage *via* Manila, Saigon, Singapore, Batavia, Penang, and Rangoon. In India the ports visited will be Calcutta, Madras, Colombo, Bombay, and Karachi, and on the way home the vessel will make a short stay at Aden, Malta, and Gibraltar. Altogether during the vessel's voyage of eighteen months a distance of 43,000 miles will be covered and thirty-four important trade centres visited. A stay of a week to a fortnight will be made at each place visited.

The vessel will be specially constructed for the purposes of an exhibition, and every detail of her equipment, from the engines to the fittings and furniture, will itself be an exhibit of British workmanship. She will be as large as a first-class liner, having a gross tonnage of 20,000 tons. There will be eight decks, four of which will be devoted to the exhibition proper. On the other decks, besides the numerous cabins set apart for the trade representatives who will undertake the journey, there will be provided a large reception hall, offices, an inquiry bureau, a bank, an insurance office, interpreters' offices, telephone exchange, writing rooms, cloak rooms, a restaurant, a cinema for exhibition purposes, a library, and other rooms.

For many years the idea of chartering and equipping a vessel as a floating exhibition of British manufacture to proceed overseas has been discussed and urged, but it has now come to be recognised that the mere conversion of an existing vessel would not adequately meet the requirements. The promoters of the present scheme realised that the first necessity was to construct a ship specially for the purpose. They therefore approached Swan, Hunter and Wigham Richardson, Limited, who have produced the design outlined above. A company called the British Trade Ship, Limited, has been formed, with registered offices at 12, Grosvenor-gardens, S.W. 1, and a board assembled under the chairmanship of Earl Grey. Among the directors are the vice-chairman, Sir G. H. Hunter (chairman of Messrs. Swan, Hunter), the Duke of Northumberland, Commander R. W. Day, Major G. P. Denton, Sir Maxwell Hicks, Messrs. J. W. Beaumont Pease, Noel E. Peck, T. E. Thirlaway, and Edmund Hill (general secretary of the Federation of British Industries). Arrangements will be made for forwarding fresh samples to meet the ship at any particular spot, so keeping the exhibition both up-to-date and appropriate to the countries visited. Thus it will be possible to change the exhibits at the last port of call in each continent. For instance, at Buenos Aires the exhibits for South America may be landed and replaced by others more suited to the Cape, and so on.

The London "Toll" Telephone Exchange.

THE volume of traffic passing over the trunk telephone system to and from London has for some years past been increasing at the rate of approximately 10 per cent. yearly. The amount of traffic which is now handled in the London Trunk Exchange is, in fact, fast approaching the limit of the capacity of that exchange, and the provision of relief arrangements has become a paramount necessity. Even before the war it was realised that a relief exchange would be required in the near future, and arrangements for its provision were under way when the war broke out. The project was, however, for both traffic and financial reasons suspended until after the Armistice, when the pressing demands of the trunk traffic rendered it imperative to take up the scheme without further delay. The Post Office therefore decided to separate the longer distance from the shorter distance trunk traffic and to erect an exchange for the express purpose of handling the latter traffic on more economical and expeditious lines. A building in Norwich-street, Fetter-lane, which had been acquired in 1914 for use as a relief exchange was available; but owing to the difficulties in the labour world and in obtaining the necessary material, it was not possible to commence the erection of the new exchange until the end of last year.

The exchange, which will be known as the London Toll Exchange, is now approaching completion, and is expected to be in full operation at the end of September. In the process of designing the switching apparatus, opportunity has been taken to introduce new facilities for the operation of the calls, so that connections to the provincial towns which are served by the exchange may be obtained on demand.

These arrangements will necessarily involve a change of procedure on the part of the public and the staffs in the London exchanges. Under the existing system, a London subscriber desiring to call any town outside the London local service area asks for "Trunks," whether the town is situated just beyond the borders of the London area, or in the remotest parts of the United Kingdom. The caller's local operator then connects him to the London Trunk Exchange, which records his call and passes it on to a switching position, where it takes its turn with others which are awaiting connection. The caller hangs up his receiver and waits until he receives a ring. Under the new system a subscriber wishing to call any provincial town within a distance of approximately twenty-five miles radially from the centre of London will ask for "Toll," instead of "Trunks." He will be connected to the London Toll Exchange, where the telephonist who answers him, besides recording particulars of the number, will herself establish the connection to the desired subscriber. In the majority of cases the call will be completed whilst the caller waits on the line, as in the local service.

In order to provide this improved service, the trunk lines from London to the provincial towns served by the new exchange have been rearranged in such a way as to place them all within the reach of every telephonist in the exchange. This has been achieved by the introduction of a multiple system, i.e., repeating the switching jacks of all the lines around the exchange. A number of cables to provide additional lines are being laid where necessary on the provincial routes, to meet the traffic requirements and to ensure a reasonable probability of a trunk line, or toll line, being available to cope immediately with every demand. Many of these lines will be ready when the new service commences; but until the service is in full operation it is possible that a short delay may be experienced on some routes during the busier hours of the day.

In addition to the traffic outgoing from London, the Toll Exchange will deal with the traffic incoming from the provincial towns involved in the London Toll scheme. The total number of exchanges and rural call offices included in the London Toll area is 270.

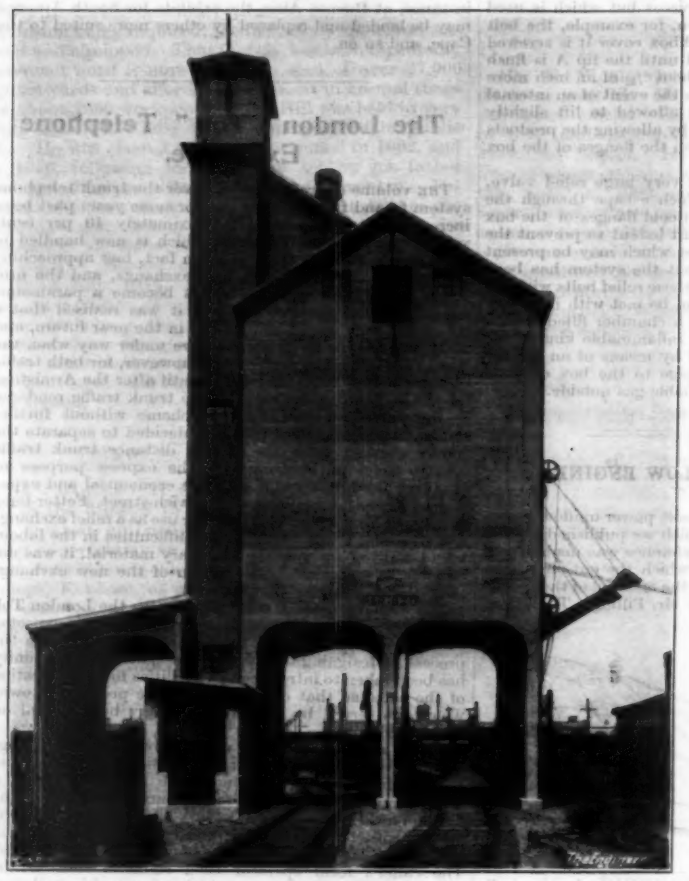
Concrete Coaling Station.

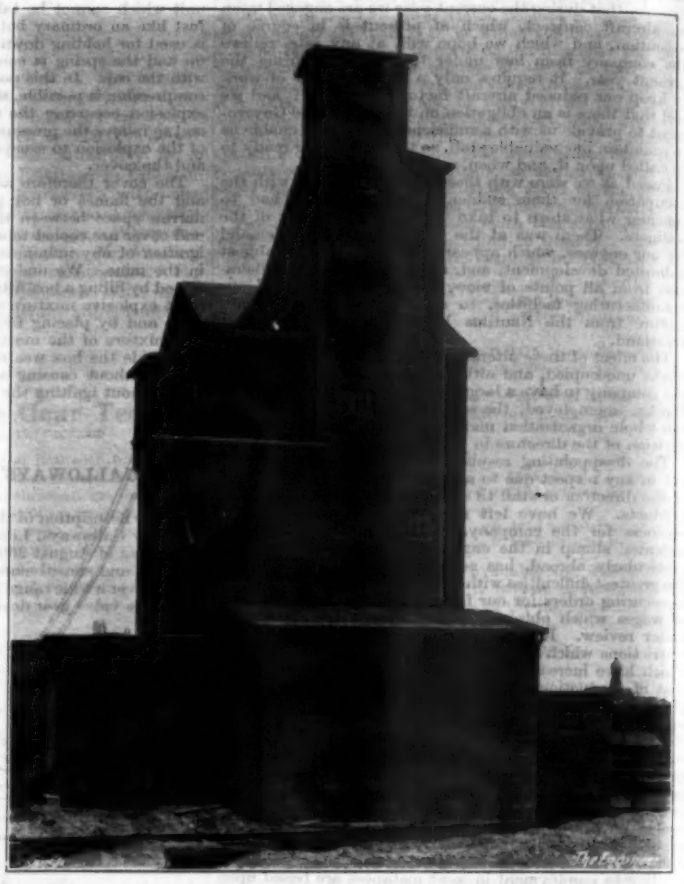
AN example of the mechanically operated coaling stations used so extensively by American railways, at which coal is stored and delivered to the locomotives with a minimum expenditure of time and labour, and to a large extent by automatic action, is presented in a plant of moderate size, illustrated herewith, built recently at the engine yard and running sheds of the Philadelphia and Reading Railroad at Philadelphia, U.S.A.

For handling the coal at stations of this kind both continuous and intermittent conveyors are used in different designs and under different conditions. The stations commonly serve engines on from two to six lines of rails. At the Philadelphia coaling station the conveyor is an intermittent vertical hoist, with a single bucket of 3 tons capacity, and possesses the unusual feature that both coal and sand for the engines are handled by the same apparatus. At this yard from thirty-five to fifty engines daily receive coal and water, besides dropping their fires at the ashpits and being cleaned and overhauled at the running sheds.

At Philadelphia, as is usual, the structure is of reinforced concrete. It consists of a tower with a hoisting shaft and a 600-ton storage bin which span two lines of rails. An engine on each of these lines and a third on an outside line can be supplied with coal simultaneously.

CONCRETE COALING STATION AT PHILADELPHIA





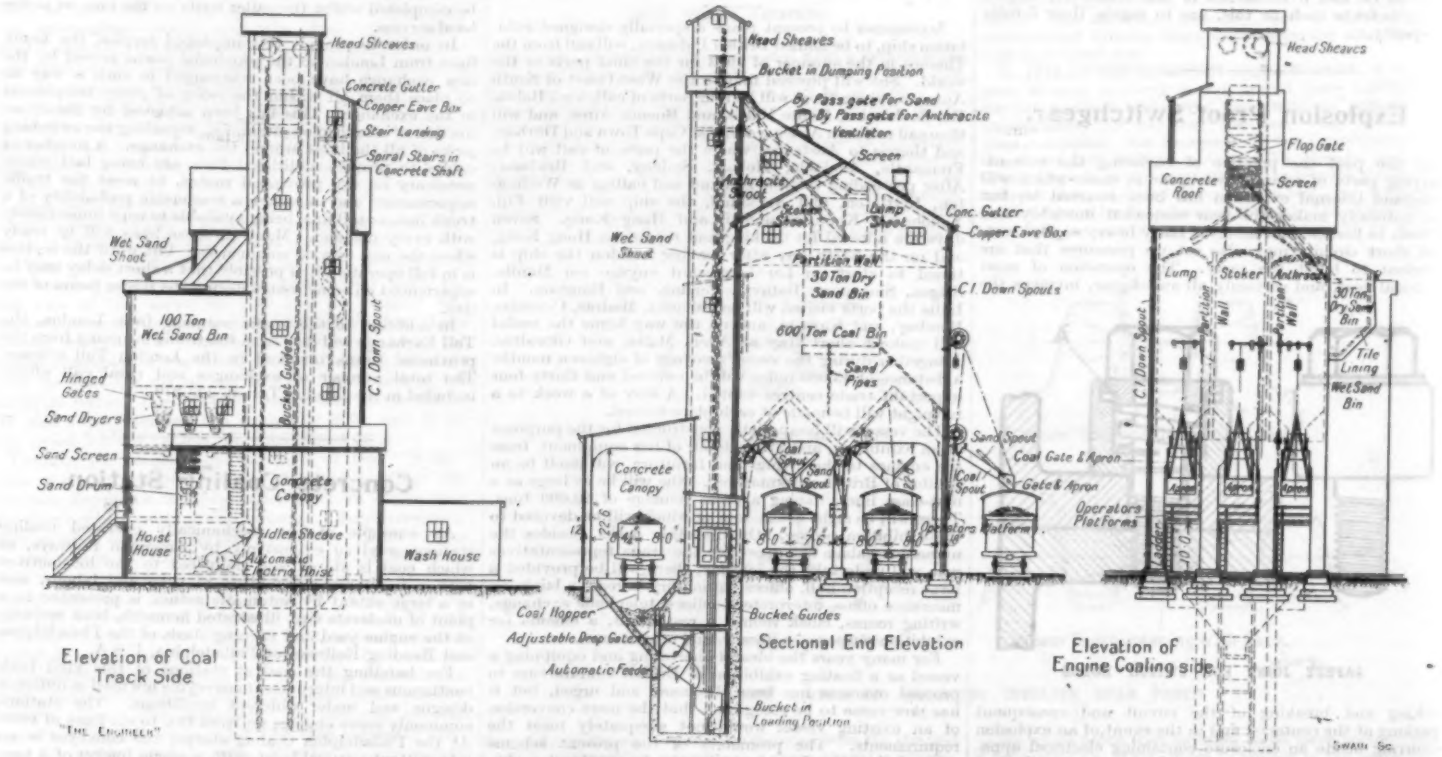
At the foot of the tower is a siding for coal wagons of 30 to 50 tons capacity, which supply the plant. This line has a slight ascending gradient from the points. Several loaded wagons are pushed to the end of this siding, and as they are required they are pulled down to the coaling station by means of a cable and winch operated from the motor of the conveyor. This winch also serves to haul away the empty wagon to make room for the next one.

At the coaling station each wagon drops its load through the bottom into a track hopper or pit between the rails. A side wall and canopy houses the wagons at the hopper and protects the men working round the wagons in bad weather. The hopper is 24ft. long, and as both coal and sand are delivered to it the sides have a slope of 50 deg., so that wet sand will not stick or lodge. The coal—or sand—flows by gravity into a tilting 3-ton measuring loader, which intermittently discharges its load into a 3-ton hoisting bucket.

As the hoisting bucket reaches the bottom of its travel it operates a drop or sliding gate, which shuts off the coal hopper from the loader, and then its upper edge engage and trips the tilting loader. As soon as the bucket is full it begins its upward movement, restoring the loader to its former position and then raising the drop gate so that a fresh charge of coal flows into the loader. When the bucket reaches the top of its travel, the hinged lower part of the side facing the coal bin is tripped and falls forward, serving as an apron over which the coal flows to an inclined trough leading into the top of the bin.

The bucket is attached to a ⅞in. wire cable on the drum of an electric winding engine driven by a 22 horse-power alternating-current electric motor, the winding engine being equipped with a solenoid brake and an automatic controller. Pairs of push buttons for the operation of this controller are placed in the hoist room and at a platform in the top of the storage bin. By pressing one button, the motor is started and the bucket continues to receive, hoist and discharge coal without further attention, supplying the storage bin at the rate of 80 tons per hour. On pressing the other button, the current is shut off and the motor is stopped by the solenoid brake.

Three kinds of coal are stored at this plant, the bin being divided into three compartments or pockets of 200 tons capacity each. The cross walls are transverse to the lines of rails. Bituminous coal is separated by an inclined screen into lump and small coal, this latter being reserved for engines equipped with automatic stokers. The screen,



GENERAL ARRANGEMENT OF COAL AND SAND BINS, AND SPOUTS

6ft. wide and 12ft. long, forms a part of the inclined shoot through which the coal flows from the hoisting bucket. It has oblong openings 2in. wide and 6in. long, the coal passing through these openings being caught on a second shoot and diverted to the proper pocket. Anthracite coal is handled also, but in this case a gate at the head of the main shoot is moved, so as to divert the flow of coal to a separate and steeper shoot leading to the third pocket.

In the same way, when sand is being hoisted, a by-pass gate diverts the flow from the bucket into another shoot which leads to a separate pocket of 100 tons capacity. The gates are operated from a platform under the concrete roof of the bin by means of chain hoists, the platform being placed in such a position that the attendant can see how the pockets are filling. From this platform, also, he can stop or start the hoisting apparatus, as noted above.

The bottom of each pocket is formed by two ridges, the sides of which have an inclination of 45 deg. Each pocket has three hinged spouts for delivering coal to the tenders, a spout for each line of rails. In this way an engine on any one of the three lines can take any one of the three kinds of coal. The outer end of the coal spout is enlarged and has a bottom opening, fitted with a controlling gate, so as to regulate the flow and to give a vertical delivery, thus avoiding the spilling of coal over the tender. An attendant operates the spouts and gates by means of chains from a platform along one side of the supporting tower, the engine firemen taking no part in the coaling operations. A tender can be given a full 15-ton load in about 45 seconds.

In addition to the handling of three grades of coal, provision is made for handling, storing and preparing a supply of sand for the engine sand boxes. Railway wagons deliver the sand to the track hopper and the bucket raises it to the top of the hoisting tower, where a gate diverts it to the 100-ton bin for wet or green sand. In the bottom of this bin are regulating gates through which the sand flows by gravity into driers in the room below. These driers are inverted cones, built up of horizontal steam pipes. They will retain wet sand, but as the sand is dried by the heat from the pipes it escapes between the coils and falls into collecting hoppers.

From each of the three hoppers the dry sand passes through a screen which removes pebbles and foreign matter, the dry, clean material then falling into a drum or receiver. When the drum is full, the inlet gate is closed automatically and compressed air is admitted at 80 lb. pressure to blow the sand through a 4in. pipe leading straight—without bends—to a 30-ton sand storage bin or pocket built on the outside of the end wall of the coal bin, as shown. To prevent condensation, this bin is lined with hollow tiles, through which circulates the hot air from the drying room.

The discharge from the dry-sand bin is effected through moisture-proof sand valves to three 4in. iron pipes leading to the three lines of rail. Each pipe is connected to a hinged spout for delivery to the sand boxes of the locomotives. These spouts are fitted with cut-off gates to regulate the flow of sand.

At one end of the coaling station is a reinforced concrete building which contains the motor, winding engine and controller. At the opposite end is a somewhat similar building with twenty steel lockers for clothes, &c., eight wash bowls and a shower bath with hot and cold water. Steam heat and electric light are provided throughout the plant.

For operating the coaling station only two attendants are required. One man looks after the hoisting of the coal and sand and their distribution to the proper bins by means of the gates and shoots. The other man handles the spouts and gates for delivering the coal and sand to the engines.

The station cost about £28,500, and was built by the Roberts and Schaefer Company, of Chicago, U.S.A., which company holds patents for a number of the details. On the basis of handling 110,000 tons of coal, the annual expense for operation and repairs is estimated at about 5½d. per ton, divided as follows:—Handling coal, 1½d. for operating and ½d. for repairs; handling wet sand, 2d.; drying sand, 1d. for operation and ½d. for repairs.

Notes on Water Power Development

ADDRESS BY PROFESSOR A. H. GIBSON, D.Sc., PRESIDENT OF SECTION G.*

THE extent to which the water powers of the world have been investigated and developed during the past decade forms one of the striking engineering features of the period. Although falling or flowing water formed the earliest of the natural sources of energy to be utilised for industrial purposes, it is of interest to note that two-thirds of the water power at present in use has been developed within the last ten years.

The reasons for the revival of interest in this question are partly technical and partly economic.

The technical development of electric generation and transmission has made it economically possible to utilise powers remote from any industrial centre, while a rapid increase in the demand for energy for general industrial purposes and for the many electro-chemical, electro-physical, and electro-metallurgical processes which are now in general use, and whose field is rapidly growing, has provided a ready outlet for all such energy as could be cheaply developed.

The urgent demand for energy to supply the abnormal requirements of the war period, combined with the world shortage of fuel, was responsible for an unprecedented rate of development in most countries with available water-power resources, and especially in those countries normally dependent on imported fuel.

Thus in France some 830,000 water horse-power has been put into commission since 1915, and the country now has 1,600,000 horse-power under control as compared with 750,000 before the war. In Switzerland some 600,000 horse-power has been developed since 1914, or is in course of construction, as compared with 880,000 horse-power before the war. In Spain, where the pre-war output was 150,000 horse-power, the present output is 620,000 horse-power, and about 260,000 horse-power is now in course of development, while the Spanish Ministerio de Fomento is considering the development of some 2,000,000 horse-power to be delivered into a network of transmission lines covering the industrial parts of the country.

In Italy, schemes totalling about 300,000 horse-power are under way, and it is estimated that the total output will shortly amount to 2,000,000 horse-power. The Government Hydrographical Department is now engaged in gauging and surveying the profiles of the principal rivers, and statistics of available reservoir sites, of lakes suitable for storage and of available horse-power are being compiled.

Japan, which only very recently began to investigate her water powers, has, since 1916, developed over 1,000,000 horse-power, or almost 20 per cent. of her available resources.

In Canada and the United States many large schemes have recently been brought into service, and some extremely large installations are now in course of construction or are projected. Thus the Queenston-Chippewa project on the Canadian side of the Niagara River is intended to develop some 500,000 horse-power, while a projected development of the St. Lawrence River will be capable of yielding 1,700,000 horse-power. In Canada the total development (2.3 million horse-power) in 1918 was almost three times as great as in 1910. In the United States of America the development has increased from something under two million horse-power in 1901, to 5.3 millions in 1908, and to nearly 10.0 millions in 1920.

Rapid as has been the development of water power in the United States in the past, it has been retarded by the fact that the privilege of using the national forests or other public lands for water-power development has only been granted by the issuing of permits which were not available for any definite period and which were revocable at the will of the granting authority. In the case of development on navigable streams, whether on public or private land, each scheme has required a special Act of Congress, and these Acts could be revoked by Congress at any time. Owing to the uncertainty of tenure there has naturally been some reluctance to invest capital in such undertakings.

By the recent Federal Water Power Act, signed in June, 1920, licences for such developments may now be issued under the jurisdiction of a new body, known as the Federal Power Commission, for a period not exceeding fifty years, at the end of which the licence may be renewed, or the Government may take over the enterprise upon compensation of the licensee. In the issuing of licences, preference is to be given to State and municipal applications. The effect of this Act may be inferred from the fact that, within a month of its being signed, applications for licences to develop over 500,000 horse-power had been filed. The duty of collecting, recording, and publishing data regarding the utilisation of water resources, the water-power industry and its relation to other industries, and regarding the capacity, development costs, and relationship to possible markets, of power sites, has also been assigned to this Federal Power Commission.

World's Available Water Power.—During the past few years much attention has been paid to statistics of available and developed water powers. In the case of developed powers, these are usually stated in terms of the capacity of the installed machinery. This machinery is in general only used to its full capacity over a portion of each day, although in many such cases water is available for providing continuous power if desired.

Estimates of potential power are always to be accepted with considerable reserve. In order to make a reasonably accurate estimate, the run off from the catchment area and the variation in this run off from month to month and from year to year, must be known, and it is only in comparatively rare cases that this information is as yet available. Moreover, there is as yet no standard basis on which potential power is computed.

The power available from a given stream during the wet season is many times as great as during the dry season unless sufficient storage is available to equalise the flow throughout the year, and the cost of such storage would in general be prohibitive, even if it were physically possible to provide it.

The United States Geological Survey takes the maximum useful flow of a stream as being that which may be guaranteed during six months in each year. The minimum flow is taken as the average which can be guaranteed over the two driest consecutive seven-day periods in each year, along with the additional flow which may be obtained during this period by developing any available storage capacity in the upper waters of the stream. Estimates of potential power based on storage capacity are, however, subject to a wide margin of error, owing to the limited data available, and in the following table the potential water power is estimated on the basis of the maximum flow as just defined, in terms of continuous twenty-four-hour power.

Millions of Horse-power.

	Available.	Developed.
Great Britain	0.9	0.2
Canada	23.0	3.28 [1]
Remainder of British Empire including—		
Australia		
Africa (East)		
,, (South)	30.0	
,, (West)	to	0.7
British Guiana	50.0	
India and Ceylon		
New Zealand		
Papua		
Austria	6.5	0.57
Brazil	20.0	0.32
Dutch East Indies	5.5	—
France	5.6	1.6
Germany	1.5	0.75
Iceland	4.0	1.0[2]
Italy	4.0	1.25
Japan	8.0	1.5
Norway	7.5	1.25
Russia	20.0	1.0
Spain	5.0	0.88
Sweden	6.2	1.2
Switzerland	4.0	1.4
United States of America	28.0	9.8

[1] Including projected extensions to plants now in operation.
[2] Projected but not yet constructed.

Adopting these figures, it appears that the available horse-power of the world is of the order of 200 millions, of which approximately 25 millions is at present developed or is in course of development.

Power Available in Great Britain and in the British Empire.—With the noteworthy exceptions of Canada and New Zealand, practically nothing had been done, prior to 1915, by any part of the British Empire, to develop or even systematically to investigate the possibilities of developing its water powers. It is true that a number of large installations had been constructed in India and Tasmania, but their aggregate output was relatively inconsiderable.

Since then, however, there has been a general tendency to initiate such investigations, and at the present time these are being carried out with varying degrees of thoroughness in India, Ceylon, Australia, South and East Africa and British Guiana. While it is known that there is ample water power in Newfoundland, Nigeria, Rhodesia, Papua and the Gold Coast, no very definite information is available, nor are any steps apparently being taken to obtain data in these countries.

The Water Power Committee of the Conjoint Board of Scientific Societies, which has been studying the state of investigation and development throughout the Empire since 1917, has, however, come to the conclusion that its total available water power resources are at least equivalent to between 50 and 70 million horse-power.

Of the developed power in the Empire, about 80 per cent. is in Canada. Throughout the remainder of its territories only about 700,000 horse-power is as yet developed, or only a little over 1 per cent. of the power available, a figure which compares with about 24 per cent. for the whole of Europe, and 21 per cent. for North America, including Canada and the U.S.A. These figures sufficiently indicate the relatively large scope for future development.

Power Available in Great Britain.—With a view of ascertaining the resources of our own islands, a Board of Trade Water Power Resources Committee was appointed in 1918. This Committee, which has just presented its final report, has carried out preliminary surveys of as many of the more promising sites as its limited funds allowed, and has obtained data from the Board of Agriculture for Scotland, the Ordnance Survey Department, the Ministry of Munitions, and from civil engineers in private practice, regarding a large number of other sites.

As might be anticipated, Scotland, with its comparatively high rainfall, mountainous area, and natural lochs, possesses relatively greater possibilities than the remainder of the United Kingdom, and investigation has shown that it offers a number of comparatively large schemes. Nine of the more immediately promising of those examined by the Committee have an average output ranging from 7000 to 40,000 continuous twenty-four-hour horse-power, and an aggregate capacity of 183,000 horse-power, while in every case the estimated cost of construction is such that power could be developed at a cost appreciably less than from a coal-fired station built and operated under present-day conditions. The aggregate output of the Scottish schemes brought before the notice of the Committee, some of which, however, are not commercially feasible at the moment, is roughly 270,000 continuous horse-power.

In addition to these, there are a very large number of other small schemes which have not yet been investigated,† and it is probably well within the mark to say that there are water-power sites in the country capable of developing the equivalent of 400,000 continuous horse-power, or 1,500,000 horse-power over a normal working week, at least as cheaply as from a coal-fired installation.

A number of attractive schemes are also available in North Wales, though these are in general more expensive than those in Scotland.

Owing to the general flatness of the gradients, there are, except possibly around Dartmoor, no schemes of any large individual magnitude in England, but there are a large number of powers ranging from 100 to 1000 horse-power which might be developed from river flow uncontrolled by storage.

Investigations on a few typical watersheds throughout England and Wales appear to show that the possible output averages approximately 8 continuous horse-power per square mile of catchment area, which would be equivalent to an aggregate of about 450,000 horse-power. Although much of this potential output is not commercially feasible, it would give the equivalent of 500,000 horse-power over a normal working week if only 30 per cent. of it were fully utilised.

In the report recently issued by the Irish Sub-committee of the Board of Trade Water Power Committee, it is estimated that approximately 500,000 continuous twenty-four-hour horse-power is commercially available in Ireland, and that if utilised over a forty-eight-hour working week, its capacity would be at least seven times as great as that of the engine power at present installed in the country for industrial purposes.

It appears, then, that, although the water-power possibilities of the United Kingdom are small in comparison with those of some more favoured countries, they are by no means so negligible as is commonly supposed, even in comparison with the present industrial steam power resources of the country.

The capacity of the fuel power plants installed for industrial and public utility services in the United Kingdom in 1907 was approximately 9.8 million horse-power. Allowing for an increase of 15 per cent. since then, and an average load factor of 35 per cent., this is equivalent to 32,000 million horse-power hours per annum, or to a continuous twenty-four-hour output of only 3.7 million horse-power.

According to Sir Dugald Clerk, the average consumption of coal per horse-power hour in this country is about 3.9 lb., which, on the above basis, would involve a total annual consumption of 55 million tons for industrial purposes, not including railways or steamships. This figure is in substantial agreement with the estimate of 60 million tons made for factory consumption in 1913 by the Coal Conservation Committee of the Ministry of Reconstruction, since this latter figure also includes coal

* British Association, Edinburgh.

† In a paper read before the Royal Society of Arts on January 25th, 1918, Mr. A. Newlands, M. Inst. C.E., gave a list of 122 potential Scottish schemes, the capacity of which he estimated on a very conservative basis, at 375,000 horse-power.

used for heating and other manufacturing processes in factories.

Adopting this figure of 32,000 million horse-power hours as the annual demand for power for industrial purposes, it appears that the inland water-power resources of the United Kingdom are capable of supplying about 27 per cent. of this, a proportion which in such an industrial country as our own is somewhat surprisingly large.

Many of the small powers would be well adapted for linking up, as automatic or semi-automatic stations, into a general network of electricity supply, or for augmenting the output of municipal supply works, as has been done so successfully, for example, at Chester, Worcester and Salisbury.

The development of the many small schemes available in the Scottish Highlands would probably have a great effect on the social life of the community. It would go far towards reviving and extending those small local industries which should form an essential feature of the ideal rural township. Commercially, such undertakings may appear to be of small importance, but as a factor in promoting the welfare of the State, economical and political, their influence can hardly be over-estimated.

Some of the larger schemes in Scotland would lend themselves admirably to transmission to its industrial districts, while others, in close vicinity to the seaboard, would appear to be well adapted for supplying chemical or electro-physical or metallurgical processes.

There is a probability that at least two of these schemes will be developed in the near future. One of these—the Lochaber scheme—is capable of developing some 72,000 continuous horse-power, which is to be utilised largely in the manufacture of aluminium. It is interesting to note that when this scheme is completed, the British Aluminium Corporation will have, with the station at Kinlochleven, an average continuous output of over 100,000 horse-power, and a maximum capacity of almost 140,000 horse-power.

The second—the scheme of the Grampian Power Company—is intended ultimately to develop upwards of 40,000 continuous horse-power, which it is proposed to use largely for general industrial purposes.

Should this latter scheme be carried to a successful conclusion, it is likely to give an impetus to large-scale water-power development in Scotland. Its successful operation would certainly lead to the development of others of the same type, which would help to provide a much-needed home training ground for British hydro-electric engineers.

While this is admittedly an inopportune moment to suggest anything in the nature of State co-operation in such developments, it may be pointed out that many of the Scottish powers in particular occur in sparsely populated districts, and that, although they would ultimately become remunerative, the difficulty of raising the capital necessary for their development is great. In view of their direct and indirect advantage to the community, it would appear not unreasonable to advocate that financial assistance should be granted by the State in the earlier stages of such developments. If such assistance, say, in the form of a loan maturing after a period of ten or fifteen years, could be granted, it would certainly give an immediate impetus to the development of water power in this country.

Conservation.—The importance of water-power development from the point of view of conservation of natural resources requires no emphasis. When the value of coal purely as a chemical asset, or as a factor in the manufacture of such materials as iron and steel, cement, &c., is considered, its use as a fuel for power purposes, when any other equally cheap source of energy is available, would appear, indeed, to be unjustifiable.

The consumption of coal in the best modern steam plant of large size, giving continuous output, would be about 9 tons per horse-power-year, and on this basis the world's available water power, if utilised, would be equivalent to some 1,800,000,000 tons of coal per annum. The world's output of coal in 1913 was approximately 1,200,000,000 tons, of which about 500,000,000 tons were used for industrial power purposes, so that on this basis 55,000,000 continuous water horse-power would be equivalent to the world's industrial energy at that date.

Not only does the use of water power lead to a direct conservation of fuel resources, but it also serves to a notable degree to conserve man-power. To take an extreme example, each of the 40,000 horse-power units now being installed at Niagara Falls will require for operation two men per shift. It is estimated that to produce the same power from a series of small factory steam plants, over eight hundred men would be required to mine, hoist, screen, load, transport by rail, unload, and fire under boilers the coal required, while, if account be taken of the additional labour involved in horse transport, wear and tear of roads and of railroad trucks and rolling stock, the number would be considerably increased.

Uses of Hydro-electric Energy.—While a large proportion of the energy developed from water power is utilised for industrial purposes and for lighting, power, and traction, an increasing proportion is being used for electro-chemical and electro-metallurgical processes. It is probable, indeed, that we are only on the threshold of developments in electro-chemistry, and that the future demand for energy for such processes will be extremely large.

In Norway the electro-chemical industry absorbed 770,000 horse-power in 1918, or approximately 75 per cent. of the total output, as compared with 1500 horse-power in 1910. Of this some 400,000 horse-power was utilised in nitrogen fixation alone.

The production of electric steel in the U.S.A. increased from 13,700 tons in 1909 to 24,000 tons in 1914, and to 511,000 tons in 1918, this latter quantity absorbing 300 million kilowatt-hours, equivalent to almost 400,000 continuous horse-power.

In Canada, in 1918, the pulp and paper industry absorbed 450,000 horse-power, or 20 per cent. of the total, while the output of central electric stations amounted to 70 per cent. of the total.

The electrification, on a large scale, of trunk line railways is also a probability in the not distant future. In the U.S.A., 650 miles of the main line of the Chicago, Milwaukee, and St. Paul Railway, comprising 850 miles of track, have been electrified, the power for operation being obtained from hydro-electric stations. In France much of the track of the Compagnie du Midi in the region of the Pyrenees has been electrified with the aid of water power; much of the Swiss railway system has been electrified; and the electrification of many other trunk lines on the European continent is at present under consideration.

Quite apart from the probable huge demand in the distant future for energy for the manufacture of artificial fertilisers by some system of nitrogen fixation, agriculture would appear to offer a promising field for the use of hydro-electric power.

Much energy is now being utilised in the U.S.A. for purely agricultural purposes. In California, for example, there is in effect one vast system of electrical supply extending over a distance of 800 miles with 7200 miles of high-tension transmission lines. This is fed from seventy-five hydro-electric stations, interconnected with forty-seven steam plants, to give a total output of 785,000 horse-power. A further group of thirteen hydro-electric schemes now under construction will add another 520,000 horse-power. A large proportion of this power is used in agriculture, and a census in 1915 showed that electric motors equivalent to over 190,000 horse-power were installed on Californian farms. The Californian rice industry is almost wholly dependent on irrigation made possible by electric pumping, while most of the mechanical processes involved in farming are being performed by electric power.

There can be little doubt that the economic development of many of our tropical dependencies is bound up in the development of their water-power resources. Not only would this enable railroads to be operated, irrigation schemes to be developed, and mineral deposits to be mined and worked, but it would go far to solve the black labour problem, which promises to be one of some difficulty in the near future.

While those outlets for electrical energy which are now in sight promise to absorb all the energy which can be cheaply developed for many years to come, there are many other probable directions in which cheap energy would find a new and profitable outlet. Among these may be mentioned the purification of municipal water supplies; the sterilisation of sewage; the de-hydration of food products; and the preservation of timber.

(To be continued.)

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Midland Furnaces Rekindled.

As I was able to announce in the Latest News column of THE ENGINEER last week, Messrs. Alfred Hickman, of the Spring Vale Ironworks, Wolverhampton, have taken the lead in South Staffordshire by starting up their furnaces for the production of pig iron and steel. These furnaces, five in number, are of a modern type and of large capacity. Messrs. Hickman's decision is regarded as the precursor of important developments in the British iron industry. There are already reports of an early conference to take place between the South Yorkshire coke producers and the principal blast-furnace concerns in Lincolnshire, which may include those of Northamptonshire also, to discuss the possibility of a *modus vivendi* in the coke position. From many quarters come reports of railway sidings being congested with trucks carrying slack, the most profitable use of which, the coal managements are said to acknowledge, is its conversion into industrial coke. There is a well-authenticated statement that the basis upon which the rekindling of the Wolverhampton blast-furnaces has been decided as possible is coke 25s. per ton at ovens, a figure repeatedly named as justifying the recommencement of other furnaces. Lloyd's Ironstone Company, whose headquarters are in Birmingham, is associated with Hickmans, and will start its two Northampton furnaces as soon as they can be got ready. It is understood that in both cases humanitarian motives have had influence on the recommencement of the furnaces, employment being desired for the unemployed men. It is reported that Midland pig iron, as well as certain lines in the finished product, will be available in a few weeks at approximately continental prices. In inner commercial circles it is believed that the fact of Belgian iron producers refusing further orders for three months ahead, and the difficulty of arranging forward shipments in other continental quarters, as reported last week, have had a direct bearing upon the improved situation in this district. Another furnace which is to start is owned by the firm of E. P. Davis, of Ilkeston, Derbyshire, and will make forge and foundry iron. The furnace is of moderate capacity, but will be useful, as Derbyshire foundry iron is decidedly scarce at present.

Pig Iron—British or Foreign.

Apart from the cases above reported, very little progress has been made in the direction of recommencing pig iron production by Midland firms generally. Furnace owners are very cautious as to relighting, in view of the very poor demand for iron. The number of idle foundries is larger than for many years past, and in several instances engineering works recently taking iron have ordered the suspension of deliveries. Current transactions in pig iron are negligible. Midland foundry irons can be bought at about £8 delivered, which is somewhat lower than the figure recently quoted, but prices are very uncertain, and most agents have instructions to submit offers to their principals before accepting business. It is thought here that when there is native iron available, prices will no longer be regulated by a ring or combination. It will be a fight to defend the market against the foreigner, who is momentarily in possession, and is able to offer foundry iron at 25s. to 30s. below the figure at which those having British iron are able to sell. Foreign competition is still very keen, Belgian foundry iron being obtainable at about £6 10s. Basic iron, however, is on offer under £5 10s. per ton, and considerable use of this material appears to be made by furnaces started to meet the requirements of certain steel works. Very heavy lots of Belgian pig iron have been offered as low as £5 10s., and in some cases it is stated even as low as £5 for delivery at the ports. The price of fuel continues to be the question of chief concern. Until this week, the lowest offer to Staffordshire ironmasters was £1 10s. per ton, but a concession of 1s. per ton is understood to have been made this week. Very much cheaper coal is called for in the interests of local ironworks.

The Manufactured Iron Market.

Most of the local ironworks have done a little business lately, operating isolated mills for occasional periods of four to five days. Several, however, are entirely without orders at present. Some little concession has been made in the price of Crown bars, iron merchants whose stocks were getting low having placed renewal orders at £15 10s. per ton, though this appears to be the lowest figure and to have been accepted by firms outside the Association. The Association price remains at £16. Makers of best iron continue fairly well employed by steady orders at £20 per ton. Iron gas strip for the time being is completely neglected. Some firms rolling this material have been idle for months, the owners stating that they could not make iron strip under something like £18. As steel bars can be utilised for a great variety of purposes in which iron has been traditionally employed, the cheaper material is being extensively used. Steel bars can be bought at £12 or £11 10s. for a big order, and a lot of business is being done by re-rolling firms on these lines. During the war the iron trade recovered a good deal of its old business in iron gas strip, but is now being ousted to a large extent by steel. Wrought iron scrap is no longer a glut on the market, and the price has firmed up from £2 10s. to £3. Demand for galvanised sheets continues to improve, and it is evident that competition is going to be keen for the work that comes along. The market level is £20 to £22 10s.

Fighting Continental Competition.

The most striking feature of the steel trade at the moment is the very low price being quoted for English billets, one large Welsh steel works having accepted heavy tonnages for delivery in October as low as £7 10s., which is a further reduction of £1 per ton. This price is well below anything which can be obtained abroad, and indicates a determination to recover the business which for several months past has been handled by Belgium. Many English steel works are, however, declining business on anything like these lines. It is believed that continental competition has now run its course, since deliveries are very unsatisfactory, and the severe cut in British prices leaves the consumer no inducement to buy his material abroad. High carbon billets have been further reduced. Large firms, it is reported, are taking orders at prices below the £11 recently fixed by the associated firms. Steel bars can be bought at £11 10s., and bedstead angles are cheaper, a concession which should help the Birmingham bedstead trade. Steel scrap is offered at remarkably low prices, £2 per ton having been named in connection with an offer of several thousand tons.

Staffordshire Manufacturers and High Cost of Fuel.

Normal activity in the iron and steel trades of the Midlands is being held up as much as anything by the present prohibitive costs of coal and coke. So far as the successful conduct of business is concerned, a substantial reduction will have to be effected before normal working conditions can be resumed. Any reductions which may be made will be useless unless they are on a considerable scale. A drop of a few pence per ton will not do if the trade of this country is to be rehabilitated successfully. At least the lower quotations, it is said, must show a decrease of 6s. 7s. or even more per ton. Mr. Gilbert C. Vyle, in an interview, intimated that if we are to get our production costs low enough to enable us to compete in the world's markets, a substantial reduction in the price of industrial coal is imperative and necessary. It is stated that there is an excess of coal available for use to-day, but until the price becomes one which will make for competitive production, coal will not be bought and plants will remain idle. Colliery owners, on the other hand, state that they are supplying industrial coal to-day at prices which do not cover working costs, and that rather than continue to go on loosing money they propose to close down the collieries. Another authority scouted the idea that manufacturers would keep their works closed down, or that collieries would not be allowed to continue operations, in order that rates of wages might be forced down. There were too many dead charges to be borne, he said, to make that worth while. The great trouble was that the coal trade was not on an economic basis. He believed that as long as they had a seven-hours day, with the resultant under-production, they would not be able to re-establish the industries of this country. The costs of coal-getting should be reduced enormously, and there were two things which were keeping these up—the seven-hours day and the rate of wages which was higher than the industry could bear. Mr. J. C. Forrest, general manager of Harrison's Collieries, speaking at a meeting on the 2nd inst., said he thoroughly believed that this country was suffering from the high price of coal as much as anything else. He was associated with certain works in the Black Country, and asserted that they could not run those works and restart the blast-furnaces owing to the high cost of fuel. He told his audience frankly, and he was ashamed to tell them, that they were importing thousands of tons of French pig iron and thousands of tons of German and French billets, whilst their own works were standing idle, at a cost of thousands of pounds a week. He was not suggesting how much coal ought to go down, but he did suggest that there were economic laws they could not ignore. Only the other day a deputation of men waited upon him and begged him to get the price of coal down so that they might get work and bread. It is generally thought in the Midlands that it should not be beyond the statesmanship of the colliery owners and those who use industrial coal to come together and discuss the needs of both sides. Those who desire to buy coal have a clear idea of what they can afford to pay, and discussion should be focussed on how and when the gap can be bridged. It

is felt, however, that whatever is done should be done at once.

Increase in Miners Wages.

The miners engaged in the Cannock Chase coalfields, in common with others in the eastern division of the federated area, under the ascertainment based on the result of the working of the industry for the month of July, in accordance with the terms of the recent settlement, are to receive an advance of wages on and from September 1st. Those over sixteen years of age will receive a flat-rate advance of 3½d. per shift and those under sixteen years of age 1½d. per shift. These advances apply to the month of September only, after which a further ascertainment will take place on the August figures.

Midland Workless.

The number of persons unemployed in the West Midlands continues to decrease, a reduction of 8000 being recorded on recent statistics. The total now unemployed stands at 183,748. The reduction is fairly general throughout the nineteen big towns in the area, there being only three—Wolverhampton, Darlaston and Wednesbury—in which slight increases have been recorded.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel and Metals.

THERE seems to be a slightly better feeling in the iron and metal markets this week, but it is so slight as to be merely the cause of uncertainty, and does not induce the consumer to buy more freely. It is generally expected that a considerable time must elapse before any confidence in the future can be generated, and confidence is wanted to bring back a better state of trade. So far as iron and steel are concerned, the utter uncertainty as to what is going to be done under the new Act for the protection of industry is a very disturbing element in the general situation. If people knew either that the Act was going to be applied to iron and steel, or that it was not going to be so applied it would be possible to form some idea as to the future; but while uncertainty on this subject prevails it is quite out of the question to form any views for the future. The powers conferred on officials under this Act are like the sword of Damocles; one does not know when or how it will fall.

Metals.

There has been some little recovery in both copper and tin from the lowest points touched during the recent depression, but one cannot clearly connect this recovery with any revival in the consuming industries. A speculative recovery, if that is all it is, cannot be considered as of any general advantage, and, of course, if a speculative recovery is not backed up by a subsequent industrial recovery it is bound to pass off and leave matters worse than they were before. The recovery in standard copper prices amounted to £3 per ton; but the relationship between standard copper and electrolytic or best select ingots remained as it was; whereas if the advance had been caused by better buying on the part of consumers the upward movement in refined copper must have been greater than in standard. No notice has been taken of the rise in standard copper by the manufacturers, and the price of strong sheets remains at £101. At the beginning of this year the price of sheets was £130 and that of standard £72, the difference being £58 per ton! To-day the difference between sheets and standard is £33 per ton, so some progress has been made in the work of getting British manufacturers to adjust their prices, although not enough has yet been done in this direction, and the consumer of copper sheets will not be satisfied until the old relationship between standard copper and sheets is re-established. Other kinds of manufactured copper and brass are more reasonable than they used to be. The market for tin recovered to a certain extent from the lowest prices, but in this case also it is doubtful whether there is any justification for the movement in the condition of trade. Certainly the engineering trade is not consuming much tin now, and there is no sign that the tin-plate trade is buying at all freely. The Eastern holders of tin have sold a fair quantity lately, but there is a considerable tonnage waiting in the East for liquidation at the least loss possible, and it may still be thrown on the market before any revival of trade enables industry to take it up. The position in lead and spelter is much as it was. Very little change takes place in the prices, but during the last two months spelter has fallen by about 10 per cent., whereas during the same time lead has not fallen at all. Rumours of smaller shipments of Spanish lead are about, but one is disinclined to take them seriously. Spain ought to be glad enough to sell while the prices remain as they are at present.

Pig Iron.

There seems to be a feeling here that the pig iron trade has slightly improved, but one has a difficulty in finding any evidence of it at present. Certainly the demand for foundry iron in the Manchester district is still very poor, and it is fairly certain that many of the local foundries are badly off for orders. This is, of course, not surprising, because the total demand for castings in the whole country is small, and of what there is Manchester cannot expect to get her share while pig iron and foundry scrap are both dearer in Manchester than in other places. Even the cheap foreign pig iron costs something extra to get it to Manchester ironfounders. It is noticeable that the Cleveland hematite makers have reduced their price for hematite pig iron to £7 per ton, so that East Coast hematite can now be delivered in Manchester at about the same price as No. 3 Derbyshire, and for £2 per ton less than Scotch No. 3. It is these grotesque anomalies which do as much as anything else to destroy the confidence of the buyer.

Finished Material.

The downward tendency in finished iron and steel still prevails and ought to go very much further yet; but there is some hope in the news that Germany is full of orders and is not now competing so keenly, so that there is a chance that Belgium and France may be able to advance their prices. If this advance takes place and at the same time British prices can be reduced by £2 to £2 10s. per ton, the hopeless gap may be filled up. Some British semi-steel (rolling billets) was offered as low as £7 10s. delivered, while at the same time Belgian billets of similar quality are quoted at £6 15s. f.o.b.

Scrap.

The market for scrap of all kinds is now very quiet, but no change has yet to be reported in the prices. The latter are quite nominal for steel and heavy wrought scrap for which there is no sale; but some little business is still done in foundry scrap, and for best quality of textile machine cast scrap up to £7 5s. per ton is asked. Common cast scrap is at £5 15s. to £6 per ton, and good broken machinery scrap about £6 5s.

BARROW-IN-FURNESS, Thursday.

Hematites.

Since last week's report there has been brought into life rather more activity in the Cumberland part of this district by the lighting of a furnace by the United Steel Company at Workington. There are four now blowing, the other three being at Ulverston, Cleator Moor and Millom. All these furnaces are engaged on high-grade iron, for which there is a certain demand. So far as ordinary iron is concerned, there is a lack of business. Consumers are still holding back for those lower quotations that have been pressed for for some time. Steel makers, on their part, are having to compete with continental makers, and must have metal at a low price. Consequently there is really nothing doing. Prices are still maintained at the same level.

Iron Ore.

There is a limited demand for hematite iron ore. Some of the pits are working on short time with only a few hands. At the same time foreign ore is being used.

Steel.

At Workington steel rails are to be rolled this week from iron smelted from French ores. Steel tires are being made at Workington from iron already held in store. At Barrow there is nothing doing apart from the rolling of hoops, and there are no immediate signs of a trade revival. Some foundry work is being carried on.

Shipbuilding and Engineering.

These trades are featureless. There is a want of orders. Short time is still being worked, and fewer men are employed than of late.

SHEFFIELD.

(From our own Correspondent.)

The Return of the Railway Canvasser.

MANUFACTURERS are very interested just now in the fight which the railway companies serving this district are commencing with the road transport people for the recovery of traffic. The latter had obtained a firmer grip on the carrying market than for a long time the railways cared to admit, but the various systems have determined, as far as ever possible, to restore the traffic business to the *status quo ante bellum*. Recently I have been chatting with an official whose duty it is to take cognisance of such matters, and he tells me the attitude of the railway companies toward manufacturers and merchants has undergone an extraordinary change in the last few weeks. The change has been coming, of course, for some time, but it was never so pronounced as at present. Beside competing with the road transport services, it seems plain that the two great Eastern and Western railway groupings are entering on a campaign of competition against each other, and my friend learns, from a very good source, that the old pre-war system of canvassing for traffic is to be revived in a keener form than ever. The results of the canvassing are to be very carefully scrutinised and analysed and railway managements intend to make it quite clear to agents that credit for these results will be on the basis of value, not mere bulk. There is a feeling that this movement will lead in the very near future to an easing of rates, which are now very heavy and often a distinct drawback so far as business is concerned, whilst it seems quite certain that the useful service which canvassers formerly considered part of their duties, viz., advising manufacturers as to the best routes for consignments and so on, will be restored. For the accomplishment of these aims, elaborate preparations are being made, I hear, by the railway companies, who, indeed, in their anxiety to get on with the business appear to be running a little ahead of the manufacturers, for the latter, while recognising that the turning in the long lane of commercial adversity has come at last, are not yet prepared to take too much for granted, and so are proceeding rather cautiously.

Profitless Contracts.

I may be taking a too hopeful view, but there seems a greater disposition on the part of labour to try to understand the difficult position occupied by capital, and if this leads, as it should do, to the removal of the suspicion that employers are simply out to secure drastic reductions in the wages of the workers, a big stride forward will have been taken in the adjustment of the industrial situation. Two things are plain. On the one hand, plenty of potential orders; on the other, an army of unemployed. The great problem is how to bring these two into contact, and it is that problem, and that problem only, that employers are endeavouring to solve. I do not believe for a moment there is a single employer in the Sheffield area, whose opinion is worth anything, but would infinitely prefer that the men should continue to receive wages plus considerable bonuses; but with foreign exchanges in their present state and with workers in the countries of foreign rivals putting in longer hours for less payment—that is to say, producing at lower costs—how is it possible for our manufacturers to secure anything like their fair share of the world's markets? It is perfectly true that now and again they do manage to obtain a big contract in open competition, but more often than not in the execution of it the workers are the only persons who derive any financial benefit. Time after time, have the leading steel firms here accepted business with no profit margin, simply for the sake of keeping certain departments open and to give work to the men. But it is quite obvious such operations cannot be continued indefinitely. They are doing nothing to re-establish trade on a sound footing. This is precisely what manufacturers in the steel industry have recognised, with the result that they are now engaged in a strong determined effort to restore the trade to a position in which it can secure business on a fair commercial basis. If to do so involves a further reduction of some kind in wages, and even an increase in working hours, it would be the grossest folly imaginable for the workers to withhold agreement to such a course, the only alternative to which is continued unemployment. Leading industrialists who know the position in this area through and through assure me that if prices can only be forced down to a point of approximation to those of foreign rivals, there would soon be no lack of employment, for in very many directions abroad there is still a strong predilection for British-made goods, which have a great name for durability.

The Blast-furnacemen's Choice.

But many of the men still seem slow to grasp the significance of the present plea for lowered costs of production. Since my previous letter a remarkable instance of what is meant has occurred at the Park Gate Iron and Steel Company's works at Rotherham. This company and its ally—the Staveley Coal and Iron Company—have some of the finest blast-furnace plants in the country, as readers of THE ENGINEER know, for the latest of these furnaces have been illustrated and described in its pages. Yet the Park Gate directors have been driven, while their furnaces are cold, to buy pig iron from Belgium. Let me relate the circumstances as detailed by Mr. C. P. Markham, who is chairman of both the companies named. Mr. Markham says the furnaces at Park Gate are standing idle, and are likely to continue to do so, because of the wages difficulty. Blast-furnacemen's wages are controlled by a sliding scale, which during the war carried them up to 280 per cent. above the pre-war basis. Since then the scale has fallen by 120 per cent., so that the rate is still 160 per cent. above the basis. Yet when the Park Gate management recently offered to restart one of the furnaces on a flat rate decrease of 2s. 6d. a day for shift men, bringing their wages to 14s. 11d. per day, they refused the offer, preferring to continue out of work and to draw the Government's dole of 20s. a week. What aggravates the situation is that, in accordance with the sliding scale referred to, and to which of course the men are parties, the rate of wages will fall automatically next month to 14s. 1d., but in the intervening month these men refuse to accept a rate which gives them 10d. a day more than the rate that comes into force in a few weeks, with the result that iron which cannot be made at Park Gate for less than £6 15s. a ton can be imported from the Continent at £5 2s. 6d. delivered into the works. Thus the Belgian and German furnacemen are getting the work and wages, whilst our men are choosing idleness and a miserable unemployment dole. That is not the British spirit, surely! If it is, we want a new one.

More About the Coal Trade.

Mr. Markham says it is not the ironworkers only, but the miners who will have to bring themselves to accept lower wages if a real trade recovery is to be allowed to develop. "At the present time," he adds, "it is costing nearly 30s. to get a ton of coal." Evidently he was not overstating the case, for this week I have received a letter from Major Gainsford, who occupies a high position in colliery circles in this part of the country, and is a director of at least one well-known concern, in which he endorses the figures of Mr. T. McLeod, of Hull, showing that the round cost of producing a ton of coal, without distinction of quality, is 32s. net at the pithead in Yorkshire. Last week I mentioned the likelihood of coal prices rising this month and falling again in October. In the course of his letter, Major Gainsford explains the position. "The figures of July last have given the miners an advance in wages for the current month," he writes. "This appears anomalous, but is the logical result of the famine prices which were offered for coal during the early part of July. The result is that the wages cut in October will necessarily be doubly severe, for the famine prices of July disappeared toward the end of that month, and the results of August, during which month the prices of small coal fell nearer 30s. than 20s. a ton, will show inevitably a very large margin of loss. A fall of 30s. in the value of slacks is equivalent to a fall of 10s. a ton on the whole output of a colliery. The only consolation, therefore, for consumers of large coal will be the feeling that their loss is the gain of our staple industries, for the fall in the price of slacks means cheaper coke for the ironworks."

General Conditions.

As to general conditions, there is no great change to be observed in the steel trade since I last wrote, nor need any be looked for. The transition from slump to activity will be a very gradual process, I believe. In passing through the works area in the east end of the city this week, one noticed the increasing number of smoking chimneys, and although it means polluting an atmosphere which had become clearer and cleaner than for many a long year, the sight brought a sense of satisfaction to the commercial and industrial mind. But there is nothing yet to warrant any exuberant congratulation on a trade recovery. The great thing seems to be that the worst has

been experienced, though I was chatting with a managing director on the day these words were penned, who declared that many of the Sheffield steel firms, "and some of the big ones, too," have an exceedingly anxious period before them. The Tinsley Rolling Mills Company expects to have its fine new mill in operation before Christmas, by which time it is to be hoped business generally will be much brighter. This addition to the company's plant should have been ready some time ago, but the work of building and equipping it was delayed by the coal strike and other things. Some of the steel manufacturers who supply case-hardened, bright drawn and other material, such as light castings, to machinery, electric tramcar and motor builders, seem to be finding business more active, but although orders are increasing in number they are still distinguished by their very modest bulk. It is in the latter that one would like to see an improvement.

The Light and Shade of Industry.

There is a moderate movement in hot stampings departments, though that is not the case invariably. A director of one stamping concern gave me this week a very striking instance of the kind of thing his firm is experiencing. The last £400 worth of work which left the place involved a net loss of £300. These people make scissor, plier and nipper blanks, beside die stocks and small forgings of various kinds. During the war they were very busy and continued so for a long time after the Armistice, but when I visited the works this week, the healthy looking, well-ventilated shops, equipped with batteries of stamps, &c., were silent and empty, with the exception of one or two men leisurely employed on some light forgings. This was one of the businesses established as a result of war conditions, to supply the things with which Germany used to furnish us, and those who launched it did so in the belief that at the close of hostilities it would receive a measure of protection for a short period, until well founded, and that patriotism would do the rest. Now the directors find the home market flooded with German goods at prices they cannot touch, and with precious little hope of an immediate change for the better. In the warehouse I saw no fewer than 3000 gross of scissor blanks, for which there is absolutely no market. You can hear similar reports in other directions, though things are not altogether as bad as that. Almost the final speech which Mr. William Clark made as Master Cutler—his successor in the office is Mr. Marmaduke Wardlow, of the Sheffield steel firm bearing his name—gave expression to the belief that in the very near future, when the new capital ships begin to be laid down, unemployment in the Sheffield district will disappear, and on the same occasion Sir Samuel Roberts, a director of Cammell Laird and Co., endorsed that view.

A Silver Wedding Party.

One turns from these considerations of trade doubts and fears to a very pleasant aspect of Sheffield's industrial conditions. Whatever relations may exist between capital and labour in the aggregate, there are numerous examples in this district of the excellent feelings which prevail between employers and employed in specific cases. One of the latter has just occurred. Mr. David Flather, the head of W. T. Flather, Limited, Standard Steel Works, Tinsley, celebrated his silver wedding day by arranging a big "family" party for the firm's employees and their wives, the proceedings consisting of an afternoon of field sports, tea in the firm's excellent canteen, and an evening of mirth and music, in the course of which Mrs. Flather distributed the prizes—all given by the firm—won in the afternoon. I mention this specially to show that the old "family" spirit has not yet died out in industrialism, and where it exists in any measure at all, communism cannot thrive. Mr. David Flather and his brother, Mr. Gerald Flather, are numbered with the model employers in this district, and deservedly so, for the firm, like many others I could name, leaves no stone unturned in the matter of welfare work, in the provision of adequate canteen accommodation, and in maintaining close personal contact with the individual employee. It is to be hoped that the restless spirit in labour ranks will not destroy this good feeling, though in some instances it must be severely strained in these days which are so trying for everyone.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Works Restarting.

There is a distinctly better feeling abroad in trade circles in the North of England. We have not yet got to the end of the difficulties which are proving such a tremendous obstacle to a normal course of things in industry generally, but some, at least, have been surmounted, and the gradual re-starting of more works may now be looked for. Indeed, there is definite news this week of three or four works having resumed operations. The steel works of Palmer's Shipbuilding and Iron Company, at Jarrow, re-started on Monday after being closed down since the first week of the coal stoppage. There is no present indication, however, of the firm's blast-furnaces being re-kindled. Fairly good progress is being made in the Cleveland district. A furnace is being put into blast at the Newport Ironworks to make hematite, and another may be set going shortly on foundry pig iron. The plant at the Lackenby Ironworks is expected to be put into active operation next week, and later in the month a furnace at the Acklam Ironworks will probably be lighted up. Preparations are also being made by the Skinningrove Iron and Steel Company to re-open some portions of its works. For the present, operations are to be resumed only at the steel furnaces and rolling mills. The re-starting of the Lackenby furnaces will involve the re-opening of the Roseberry ironstone mines at Great Ayton, thereby providing employment for some of the unemployed Cleveland miners.

Iron and Steel Exports.

Though considerably below the normal average, the exports of iron and steel from the Cleveland district during August showed a gratifying increase over those of the few previous months. Moreover, they indicate that notwithstanding the relatively high prices prevailing here, there is still a market abroad for our iron and steel, and with prices more favourable to buyers our export trade would show a rapid expansion. The exports of manufactured iron and steel, in particular, showed a big increase. Whereas in July the total was only 4060 tons, last month 22,097 tons were exported, an increase of 17,137 tons. The foreign shipments accounted for 19,325 tons of the total, 2772 tons being sent coastwise. The principal buyers were India and Ceylon with 4634 tons, African Colonies and Dependencies 4892 tons, Australia 2957 tons, New Zealand 2882 tons, and Uruguay 1182 tons. The pig iron exports were not so satisfactory, remaining at the low level of 6116 tons, which, although 876 tons better than the July total, is a very long way indeed from the normal pre-war monthly average of some 60,000 tons. Moreover, only 1381 tons were actually shipped abroad, the remainder going coastwise, mainly to Wales and Scotland, whereas in July 3205 tons went abroad.

Cleveland Iron Trade.

Although there is a slightly more hopeful feeling with regard to the outlook in the Cleveland iron trade, it cannot be said that there has been any real expansion in business. Prices are still too high either to encourage the demand at home or to enable producers to compete successfully abroad, and although possibly the spate of foreign iron imported here has exhausted itself, cargoes are still coming across at prices lower than those quoted locally. The abundance of cheap steel scrap enables consumers to use the cheap basic iron from abroad for mixing, and steel makers have consequently not been in a hurry to light up their blast-furnaces. Still progress is being made in this latter direction, and there are now fifteen actually turning out iron. There is still a little No. 3 G.M.B. Cleveland pig iron to be had, but consumers are reluctant to pay 135s. per ton, and only seek to cover their immediate needs. No. 4 foundry is more plentiful, but here again 125s. is regarded as too dear, and makers find great difficulty in disposing of any of the lower qualities, which, however, are kept firmly at the recent minimum figures, namely, 117s. 6d. for No. 4 forge and mottled, and 115s. for white iron.

Hematite Pig Iron.

Even with the increased production of East Coast hematite there is not a great quantity available at the moment, as stocks had been pretty well depleted. Makers are, however, very ready to accept forward contracts at 140s. for mixed numbers and 142s. 6d. for No. 1. There is, however, no pressing demand at home, and foreign buyers regard the price as still too high. A few small lots appear to have been sold at 140s., but whereas the home price is governed by an agreed minimum, there is a free market for foreign sales, and about 135s. per ton is mentioned as the export price of mixed numbers.

Iron-making Materials.

There is still no business in foreign ore, but coke is, if anything, a little firmer, and it is doubtful if good furnace coke could now be bought at 35s. per ton delivered at the works. Some sellers put the price at nearer 45s., and are not disposed to cut prices when, as they declare, it would simply involve production at a loss.

Manufactured Iron and Steel.

Whilst it is true that more steel works are re-starting and a few small orders have been booked, it would be misleading as yet to speak of any real revival in the manufactured iron and steel trade. The recent price cuts have brought in a few specifications from buyers who could not afford to wait much longer, but confidence is lacking all round, and with the belief prevalent that the end of the fall in prices has yet to come, it is the settled policy to hold off the market to the last possible minute. Thus the outlook is still uncertain, but producers are making every sacrifice to get orders, and generally they quote for foreign business substantially less than the home prices

The Coal Trade.

The Northern coal trade remains generally quiet and void of violent fluctuations. Prices have gradually receded until they have reached a level which the owners of the collieries state to be well below the cost of production, but even at present values there is a decided and quite evident diffidence on the part of prospective buyers to operate. As an indication of the sensational movement in values it may be recalled that the top figure for best steams last October was 160s., while the nominal figures now are 27s. 6d. to 30s., and even at these figures business is very shy. Unless cheaper coal can be offered, the outlook for the export trade is not in any sense cheerful. The inquiry is certainly a little better both for Northumberland and Durham, and is of a rather more varied character, but when it comes to actual business transacted there is not much to occasion satisfaction. The Norwegian State Railways are in the market for 30,000 tons of best steams for delivery during October and November. This inquiry is the largest from that quarter for a long while past, and looks like a return to something more like the normal buying. There is also an inquiry in circulation from the Paris gasworks. No actual quantity is mentioned, but as it is intended to buy from three to six months' supply of various brands of gas coals, the contracts, if placed, would be large. It is also reported that the South Metropolitan Gas Co. has purchased two month's supply of second gas coals at 27s. 6d. per ton, which is considered a fair price and something like an index as to possible forward values. The coke market is moderately steady, with a shade better inquiry for foundry and furnace kinds. Gas coke is in much better request, and prices have stiffened up quite appreciably.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding Returns.

Though the number of craft launched on the Clyde during August was large, the aggregate tonnage was low. The output, consisting of thirty-four vessels of 34,616 tons, compares with twenty-seven vessels of 87,912 tons in August of last year, while in July this year the thirteen vessels aggregated 29,448 tons. The number of small craft was abnormal, and included fifteen ships' lifeboats, three motor lifeboats, two steam pinnaces, and a motor towing lifeboat. Among the larger craft a noteworthy feature was the launching of two motor ships, one of 9500 tons for the Royal Mail S. P. Co., London, and one of 7000 tons for the Union Steamship Company of New Zealand. Other launches included the Clan Macnaughton, a cargo steamer of 6100 tons, for the Clan Line, and the Jose Marendez, 4500 tons, for Brazilian owners. The output from the Clyde to date amounts to 165 vessels of 290,864 tons compared with 142 vessels of 440,174 tons in the same period last year.

Prospects.

The outlook is far from bright. In the meantime there is more activity at the shipyards, but this is due to the resumption of the joiners and not to any increase in business. Work is now proceeding on vessels held up during the joiners' strike. New contracts are exceptionally scarce, and local quotations do not hold any inducement to owners. Shipyard wages have dropped a little, but other oncosts remain very high. The motor ship is apparently increasing in popularity. Several are on hand on the Clyde, while those works constructing marine internal combustion engines have a large number of orders for Diesel engines. In view of prices recently obtained for second-hand tonnage of comparatively new construction, prices of new vessels have a long way to drop before owners will be tempted to order new steamers.

Pig Iron.

Apart from the putting into operation of one or two furnaces, for the production of foundry pig iron, there is practically nothing doing in the pig iron trade. Foundry quality has dried up and stocks must be maintained at a certain level if only to overtake the small number of orders which are constantly in circulation. The production must necessarily be limited unless local makers can see their way to bring prices into line with those for imported material.

Steel and Iron.

Conditions in the steel and iron trades are far from brisk. Orders for steel plates and sheets are very occasional and quite insufficient, generally speaking, to keep even a restricted number of mills constantly occupied. Another two or three reductions on a similar basis to the latest decrease will be required before any impetus can be given to sales. Considerable competition for orders for sectional material is reported. Keen cutting is said to be in progress, and £12 per ton is mentioned as the figure at which business has been done. As regards sheets there are indications that whenever prices are in accordance with the ideas of the consumers good business will be done with Africa, South America and the Far East. The bar iron works are going very slowly. With the basis price still at £16 for Crown bars, business is well-nigh impossible. Meantime, it is said that a large amount of business, both for local and overseas delivery, is passing to continental makers. Export is dull. Fair inquiries for structural material and electrical machinery are to hand, but it is improbable that matters will proceed beyond the inquiry stage so far as home makers are concerned.

Steelworkers and Trade Unionism.

The new association known as the Scottish National Trade Union Association continues to add to its strength. This organisation believes solely in constitutional methods in negotiation with the employer and in the elimination of the strike weapon. This union should include all trades, assuming that all workers must be affected by what occurs in any one big trade. The movement is really one result of the recent coal strike, and a protest in a measure against the intrusion of the political agent into trade union organisation and the exploitation of members for political purposes. Three branches have already been formed, and last week-end a further addition was made as the outcome of a meeting at the Clydesdale Iron and Steel Works Institute, Mossend.

Coal.

Business in the coal trade proceeds on very discouraging lines. Despite all reductions in prices the various markets remain glutted with supplies, while consumers show no inclination to depart from buying on the day-to-day principle. Prices have fallen in some cases almost 50 per cent., but buyers seem to be prepared to wait and see if the pre-war level will be nearer realisation before purchasing on the old scale. Splint coal has dropped from 50s. and over, to 30s. and under per ton, ells from 48s. to 26s., and other grades and qualities to a similar degree. House coal now sells at 2s. 7d. per cwt. bag, and 2s. 6d. to 2s. 5d. per ton loads, against the former price of 3s. 9d. to 4s. per cwt. At present, however, industrial and house coal orders are scarce, and of minimum bulk, and the export turnover, though a little better, is of a fluctuating nature. Consequently collieries are irregularly employed, and considerable distress is rife amongst the workers. In some cases, too, only one shift is being worked instead of two. The number of steamers loading Scotch coal is not more than about twenty all told. Shipments amounted to 139,634 tons against 126,577 in the preceding week and 333,710 tons in the same week in 1913. The returns from the West of Scotland and Fifeshire show an increase, but the Lothian figures are almost 50 per cent. down on the week.

Miners' Claim Upheld.

A claim for unemployment benefit on behalf of miners at Prestongrange and accepted by the Court of Referees has been approved by the Insurance Officer in London without appeal to the umpire. Since the resumption of work the arrangements at the pit where these men were formerly engaged have been altered from two to one shift, and the workmen have been unable to gain employment either there or elsewhere.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Trades Union Congress.

LABOUR'S Parliament, the Trade Union Congress, opened at Cardiff on Monday, and will continue in session throughout the whole of this week. It is twenty-six years since the Congress was held in the Welsh Metropolis, and on that occasion there were about 330 delegates, representing 170 unions with a membership of 1,000,000. This week there were about 823 delegates, representing 823 unions with a membership of over 6,416,510. The forces of labour have increased considerably, both numerically and in influence, though it cannot be denied that the strength of its influence is diminished by the divisions in its own ranks. As the President, Mr. E. L. Poulton, pointed out in his presidential address, they had gone through an industrial maelstrom during the past year, and he pleaded hard for unity and discipline within their own ranks. Naturally, the question of unemployment figured prominently in the Congress discussions, but the fault was, of course, laid on the misgovernment of the country, and blame was apportioned to all classes except their own. Labour's fitness to govern was reared on the destructive criticism of all other classes to rule, the President observing that he firmly believed that within a short period of Government by labour, it would be shown how much better labour could conduct the business of the world than the favoured classes have done up to the present time. Of course, it was quite in the order of things that there should be a little theatrical display, and in order to help to impress the public, an unemployed demonstration was organised and marched to Cardiff from the Caerphilly district. A deputation waited upon the Congress, and this provided a somewhat lively interlude, one of the speakers, Mr. A. Maclean, representing the unemployed of Scotland and the Sheffield area, stating that failing work, they wanted full maintenance and that must not be a penny less than what they could earn at work. The President assured the deputation that due regard to the statements made would be paid when resolutions on the subject came before the Congress. It was not surprising that particular reference should have been made to the recent miners' strike, but it does not inspire belief in the sincerity of the President's remarks when he described what is generally regarded as a national disaster as an epic struggle.

Winding Enginemen.

A Committee appointed by the South Wales Coalowners' Association and representatives of the South Wales Colliery Winding Enginemen's Association has arranged a new agreement, which provides that existing standard rates which have not been converted into 1915 standard rates, are to be so converted in accordance with the procedure adopted in 1915 in connection with the standard rates of other workmen. The 1879 standard rates of 4s. 3d., or the equivalent 1877 standard rates, are to be increased to 4s. 6d. on the 1879 standard or the equivalent on the 1877 standard, and are then to be converted into 1915 standard rates. The wages payable in September will be the same as in August, subject to a reduction of 6d. per shift as from the 1st inst. This new agreement comes into operation on October 1st next.

Colliery Managers and the Coal Trade.

Last week the National Association of Colliery Managers held their annual meetings in Cardiff, and their proceedings were invested with more than ordinary interest in view of the changed conditions and the new agreement affecting the industry. Dealing with this question, Mr. A. S. Tallis stated that the managers had it largely in their hands as to whether or not the new agreement would be a success, and it was for them to show the workmen the advantages that might be derived from the new agreement. He hoped the managers would assist the owners by impressing on the workmen that they should assist the management by permitting the introduction of new and improved methods of working which would all be to their benefit in the long run. One of the things that would be chiefly instrumental in bringing costs down in South Wales would be the introduction of the double shift, especially as at present the collieries were only engaged on productive work for 3½ hours out of every twenty-four. The colliers would probably say in reply that it was no use talking about double shifts when they could not get sufficient work to keep them going as they were. If there were too many men in the industry, those who came in last should go out first. Then the owners could close down the unremunerative districts, and work other districts quicker and better. Once the men got over their prejudices to the double shift, they would agree it was one of the finest revolutions in coal mining that South Wales could have. One very interesting announcement was made by the new President, Mr. John Kane, of Wattstown, who stated that there was a resolution on the books of the Colliery Managers' Association of South Wales that if Pit Committees were established, none of the colliery managers would take any part in them. In South Wales, where there were 614 collieries and 340 members of the Association, there would be no deviation from that decision.

Miners' Contributions.

The special conference of delegates from the South Wales coalfield adopted the recommendation of the Executive Council of the Federation reducing the miners' contributions from 4s. to 2s. per month, in view of the prevailing economic conditions. This decision was come to without much discussion, and although reference was made to the resuscitation of the Enginemen's and Stokers' Association, and views were expressed strongly condemning the movement to break away from the Federation, no resolution was formally agreed to. It is, however, symptomatic of the anxiety of the miners' leaders regarding the tendency of their members to fall out, and the existence of keen dissatisfaction among the workmen, that the Executive Council should have issued a manifesto to the delegates pointing out the success achieved by the Federation in the past and its capacity to promote and maintain the interests of its members in the future. After setting forth the benefits derived by the members in the past, the manifesto deals with the attacks made on the Federation on the ground of extravagant administration, and in order to show how baseless these charges are, it is stated that during the last ten years—1911–1920—the total amount contributed by members to the central fund was £1,073,452 7s. 1d. During the same period, not less than £910,415, representing 84.81 per cent. of the amount contributed, has been returned to the members as strike, lock-out and out-of-work pay. The administration expenses, including the expenses of the Conciliation Board, disputes, salaries, &c., are only 8.05 per cent., or less than 1d. out of every shilling received into the fund.

Training for the Sea.

On October 3rd the Smith Nautical School at the Cardiff Technical College is to be opened, and thus will be brought to fruition the efforts of Sir William Reardon Smith, Bart., and other local shipowners to establish a first-class scheme for the training of officers for the mercantile marine. It will then be possible to give, at a fee of only 1s. per week, an education in preliminary nautical science that would cost parents from £100 to £200 per annum if their sons were sent to one of the few established schools. A three years' course of study, including mathematics, science, navigation and nautical astronomy, the ship, business correspondence and reports, physical exercises and manual work, and signalling, including wireless, has been provided for pupils of about thirteen years of age, while in special cases pupils of about fifteen years may join the third year or cadet course direct. It is probable that the Board of Trade will recognise the school by counting a portion of the school training as equivalent to sea service. An excellent staff has been provided, and it is fully expected that the Smith Nautical School will shortly rank as one of the foremost of its kind in the country.

Employment Conditions.

The conditions regarding employment in South Wales are extremely variable. The Pengam House Coal Colliery, owned by the Powell Duffryn Company, is to be closed down, and on Monday last 800 men employed there received notices. The reason given for this action is bad trade. On the other hand, trade in the anthracite district is good, and in the Neath district practically all the pits are in full swing, double shifts being worked in the case of four. Unemployment in the Swansea area is diminishing, and more works resumed operations this week, one of these being the Wellfield Galvanising Works, Llanelly, which have been idle for a year. Altogether about 35 per cent. of the tin-plate mills of South Wales and Monmouthshire are operating.

Current Business.

There has been no appreciable improvement in business on the steam coal market, and operations for early shipment can only be described as on the slack side. Buyers abroad are not doing much for the moment, and are still holding the belief that prices will yet fall further. Coalowners, however, are adhering very firmly to their prices, and in the event of failure to obtain them are prepared to stop output. To make any further cut for early loading simply resolves itself into working at a loss in the case of many undertakings. Reports are current that the French State Railways have provisionally contracted for 20,000 tons of best Monmouthshire black veins or Western Valley large, for delivery over two months from the date of the final placing of the business, of which two-thirds will be for North French ports and one-third for Bay ports. It is understood that the definite placing of the order will not be made for a few days at least, as the railways have informed the firms which tendered what the lowest price sent in is, and they have the right to accept any offer which may be 10 per cent. below the present lowest figure. Should there be such an offer forthcoming, the firm which originally sent in the lowest quotation will be given the opportunity of reconsidering its price. Such a method of dealing with tenders does not meet with a great deal of approval in coal trade circles, as it is a very forcible method of beating down prices. It is reported that one firm associated with collieries, has made an offer to supply the coal required at a c.i.f. price of about 83f., which is equal to about 35s., and on the basis of current freight rates, leaves practically no profit. The Paris, Lyons and Mediterranean Railway is also reported to have contracted for 50,000 tons of Welsh coals, for delivery up to the end of the year, but details as to the quality and price have not been disclosed. The Norwegian Railways are also inquiring for 30,000 tons of best steam coals.

Latest News from the Provinces.

SHEFFIELD.

Prices Unchanged.

At its meeting on Monday, the South Yorkshire Bar Iron Association made no change in the basis price of bars, which therefore remain at £16 net for "Crown" and £17 for best. No alteration is reported in the "official" quotations of pig iron and steel billets, but it is said that rather considerable quantities of both are being imported from the Continent. It is now generally understood that falls in coal prices may be looked for in October and November, and the quotation of coke, which is now 30s. and done down to 25s., is expected to be lowered very soon. Slacks are accumulating to a greater extent than ever at the colliery sidings, and common slacks, suitable for the cotton mill districts, are now at 5s. to 8s. a ton at pit, against 25s. to 35s. not long since. The comparatively low price of coke contrasts with 65s. to 85s. in recent years.

LANCASHIRE.

BARROW-IN-FURNESS.

Furnaces Restarting.

THE Barrow Steel Company will put a furnace into operation on Monday, September 18th, and preparations are now in hand for that purpose. At Backbarrow the Charcoal Iron Company, Limited, put its cold blast furnace into operation on Wednesday of this week.

WALES AND ADJOINING COUNTIES.

Swansea Metal Exchange.

There is comparatively little business being done in tin-plates, and prices are a shade easier. Steel prices on this side are slowly getting nearer continental figures, and it is reported that as soon as the conditions become steadier some big contracts are likely to be placed. Galvanised sheets are quiet in demand, business having been done at £20 for 24 gauge corrugated in bundles.

CATALOGUES.

JAMES WILEY AND SONS, Limited, Darlaston, Staffs.—New lists have now been prepared by the firm, which deal with bolts, nuts, rivets and washers.

BRITISH INSULATED AND HELSBY CABLES, Limited, Prescot, Lancs.—General descriptive catalogue of the firm's manufactures. Illustrations of different articles produced are given.

COWLISHAW WALKER AND CO. (1920), Limited, P. and O. House, 14–16, Cockspur-street, S.W. 1.—Illustrated catalogue dealing with the "Output" bar coal cutters. The apparatus is illustrated in operation.

CITY ELECTRICAL COMPANY, 1, Emerald-street, W.C. 1.—Illustrated edition of the Mersey list dealing with motors, dynamos, motor generators, direct-coupled steam and oil engine sets, in all types, with prices.

GENERAL ELECTRIC COMPANY, Limited, Magnet House, Kingsway, W.C. 2.—Revised catalogue prices of electric lighting supplies appearing in S (1) section of catalogue, thirteenth edition. Catalogue P (5) section, fourteenth edition, deals with electrical plant.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE SCOTTISH TUBE COMPANY, Limited, Glasgow, has opened an office and warehouse at 44, Victoria-road, Holbeck, Leeds.

MR. R. J. FIRESTONE, has been elected a vice-president of the United States Motor Truck Company, Cincinnati, Ohio, U.S.A.

MILLS ELECTRICAL COMPANY, 17, Whitefriars-street, E.C. 4, has been appointed by G. Meidinger and Co., of Basle, Switzerland, as their sole selling agent for Great Britain and the Colonies.

MR. E. E. HOADLEY, M.I.E.E., engineer and manager of the Corporation electricity supply undertaking at Maidstone, has been appointed hon. secretary of the Electric Vehicle Committee in succession to Mr. F. Ayton, M.I.E.E., who has held the position since the Committee's inception, and who resigned upon his appointment as joint managing director of Ransomes, Sims and Jefferies, Limited.

BRITISH OIL AND FUEL CONSERVATION, Limited, of 9, Southampton-street, London, W.C. 1, announces that it has taken over works at Willesden, where it is erecting laboratories, retorts and distilling apparatus, to demonstrate its plant for complete low and high temperature treatment of coals, shales and lignites, under the direction of its technical director and patentee, Mr. N. H. Freeman. The laboratories and retorts are now available for testing material from British, overseas and foreign sources.

EGYPTIAN GOVERNMENT CONTRACTS.—His Majesty's Commercial Agent for Egypt desires to call attention to the fact that contracts for the supply of goods to the Egyptian Government have been lost through the failure on the part of British firms to comply with the conditions of tender. These conditions stipulate that tenders can only be submitted by firms having a resident agent in the country, and that tenders should be accompanied by a provisional deposit of 2 per cent. of the value of the offer in money. This provisional deposit may be replaced by a letter of guarantee from an approved bank in Egypt, and does not therefore necessarily involve any outlay of capital. Copies of the general conditions of tender which form the basis of the conditions which apply to all public tenders, may be obtained on application at the Department of Overseas Trade, together with a memorandum of information for the use of those United Kingdom firms who are desirous of submitting tenders for Egyptian Government contracts.

R.A.C. OFFICIAL DEMONSTRATIONS.—The Royal Automobile Club has, we are informed, made an innovation in the way of a development of the official certified trials. The method of carrying out these trials is necessarily so elaborate as to be too cumbersome to be applied to tests of simple devices, such, for instance, as a thief-proof car lock or such an article as a petrol can opener. These and similar devices, by their nature, would not appropriately be the subjects of a certified trial, but for them, nevertheless, there are certain claims that could readily be substantiated by demonstration. The Club has now inaugurated a system of official demonstrations of motor accessories and fittings which will serve this purpose. The regulations under which the official demonstrations will be conducted state that the object of the demonstrations is to test the merits of a device—defined as any part of a car, an accessory, a tool, or a material—and make it clear that the Club will only admit to demonstration such articles as are more suitable subjects for demonstration than for certified trials. The Club will issue a public report of every device that is submitted for test. These reports will be of a less formal character than the certificates of performances issued in respect of R.A.C. official trials.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	—
[1] Spanish	28/-
[1] N. African	28/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	37/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—[2]		
Hematite	9 0 0	—
No. 1 Foundry	8 15 0	—
No. 3 ,,	8 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	7 0 0	6 15 0
No. 1	7 2 6	7 2 6
Cleveland—		
No. 1	—	—
Silicious Iron	—	—
No. 3 G.M.B.	6 15 0	6 15 0
No. 4 Foundry	6 5 0	6 5 0
No. 4 Forge	5 17 6	5 17 6
Mottled	5 17 6	5 17 6
White	5 15 0	5 15 0
Midlands.		
Staffs. *(Nominal).*—		
All-mine (Cold Blast)	17 0 0 to 17 7 6	
Part Mine Forge	7 0 0	
,, Foundry No. 3	8 5 0 to 8 15 0	
Northampton [3] *(Nominal).*—		
Foundry Nos. 2 and 1	8 2 6	
,, No. 3	7 12 6 to 7 15 0	
,, Forge	6 17 6	
Derbyshire [3] *(All nominal).*—		
No. 3 Foundry	7 0 0 to 7 5 0	
Forge	6 10 0	
Lincolnshire [3]—		
Basic	*Uncertain.*	
Foundry	,,	
Forge	,,	
N.W. Coast— [4]		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	7 15 0	

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
N.E. Coast—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Tees	14 10 0	—
Lancs.—		
Crown Bars	16 0 0	—
Hoops	20 5 0	20 0 0
S. Yorks.—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Hoops	20 5 0	—
Midlands—		
Marked Bars (Staffs.)	20 0 0	—
Crown Bars	16 0 0	—
Nut and Bolt Bars	15 10 0 to 16 0 0	
Black Sheets (dbls. nom.)	17 0 0 to 17 10 0	
Galv. Sheets, 24 W.G. (f.o.b. L'pool, or equal)	20 0 0 to 22 10 0	
Gas Tube Strip	18 0 0 to 20 0 0	

STEEL.

	Home.[6] £ s. d.	Export.[7] £ s. d.
Scotland—[5]		
Boiler Plates	19 0 0	—
Ship Plates ¾in. and up	14 0 0	—
Sections	13 10 0	—
Steel Sheets ⅛in. to ¾in.	15 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	24 0 0

STEEL (continued)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	14 0 0	14 0 0
Angles	13 10 0	13 10 0
Boiler Plates	19 0 0	19 0 0
Joists	13 10 0	13 10 0
Heavy Rails	14 0 0	—
Fish-plates	19 0 0	—
Channels	14 10 0	—
Hard Billets	11 0 0	—
Soft Billets	9 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	14 0 0	—
Light ,,	16 0 0 to 18 0 0	
Billets	13 0 0	—
Ship Plates	14 0 0	—
Boiler ,,	20 0 0	—
Manchester (*Prices irregular and uncertain, unchanged*)—		
[8] Bars (Round)	13 0 0 to 14 0 0	
[8] ,, (others)	14 0 0 to 15 0 0	
Hoops (Best)	20 5 0	20 0 0
,, (Soft Steel)	17 5 0	17 0 0
Plates	14 0 0	—
,, (Lancs. Boiler)	20 0 0	—
Sheffield—		
Siemens Acid Billets	16 0 0	—
Bessemer Billets	15 10 0	—
Hard Basic	13 0 0	—
Soft ,,	11 0 0	—
Hoops	17 5 0	—
Soft Wire Rods	13 15 0	—
Midlands—		
Small Rolled Bars	11 10 0 to 13 0 0	
Bessemer Billets and Sheet Bars	7 10 0 to 8 10 0	
[2] Hoops	17 0 0	—
Tube Strip	12 10 0 to 13 10 0	
Angles and Joists	13 10 0	—
Tees	14 10 0	—
Bridge and Tank Plates	14 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	22/- to 23/-
Block Tin (cash)	161 15 0
,, (three months)	163 15 0
Copper (cash)	68 17 6
,, (three months)	69 17 6
Spanish Lead (cash)	23 5 0
,, (three months)	22 15 0
Spelter (cash)	25 0 0
,, (three months)	25 15 0
Manchester—	
[9] Copper, Best Selected Ingots	71 0 0
,, Electrolytic	74 10 0
[10] ,, Strong Sheets	101 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0½
,, Condenser	0 1 4½
Lead, English	24 5 0
,, Foreign	23 0 0

(*Metal prices practically unchanged*).

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/6 to 1/8 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£36	12/-
,, 6 p.c. to 8 p.c. ,,	£34	12/-
,, 8 p.c. to 10 p.c. ,,	£34	12/-
,, Specially Refined		
Max. 2 p.c. carbon	£79	28/-
,, 1 p.c. ,,	£94	32/-
,, 0·75 p.c. carbon	£110	41/-
,, carbon free	2/8 per lb.	
Metallic Chromium	5/6 per lb.	
Ferro Manganese	(per ton) £18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	22/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£190	
Cobalt	15/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

	Export.
Scotland.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	25/6
,, ,, Ell	26/6
,, ,, Splint	27/- to 31/-
,, ,, Trebles	29/- to 30/-
,, ,, Doubles	27/6
,, ,, Singles	25/-
Ayrshire—	
(f.o.b. Ports)—Steam	25/-
,, ,, Splint	26/6
,, ,, Trebles	29/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	22/6 to 26/-
Screened Navigation	32/6
Trebles	28/-
Doubles	26/-
Singles	24/-
Lothians—	
(f.o.b. Leith)—Best Steam	23/6
Secondary Steam	23/-
Trebles	30/-
Doubles	27/-
Singles	25/-
England.	
[11] N.W. Coast—	
Steams	44/-
Household	56/6 to 60/-
Coke	37/6 to 42/6
Northumberland—	
Best Steams	27/6 to 30/-
Second Steams	25/- to 27/-
Steam Smalls	15/- to 17/6
Unscreened	22/6 to 27/-
Household	30/- to 35/-
Durham—	
Best Gas	30/-
Second	25/- to 27/6
Household	30/- to 35/-
Foundry Coke	45/- to 55/-
Sheffield—[12]	
S. Yorks. Best Steam Hards	33/2 to 33/8
Derbyshire Hards	32/8 to 33/2
Seconds	31/8 to 32/2
Cobbles	31/8 to 32/2
Nuts	31/2 to 32/2
Washed Smalls	28/8 to 30/2
Best Hard Slacks	20/- to 25/-
Seconds ,,	20/- to 23/-
Soft Nutty	20/- to 25/-
Pea	18/- to 22/-
Small ,,	15/- to 18/-
House, Branch	37/2 to 37/8
,, Best Silkstone	33/8 to 34/2
Blast Furnace Coke	30/-
Cardiff— [13] **South Wales.**	
Steam Coals:	
Best Smokeless Large	32/6 to 34/-
Second ,,	32/- to 32/6
Best Dry Large	31/6 to 33/-
Ordinary Dry Large	30/- to 32/6
Best Black Vein Large	30/- to 31/-
Western Valley ,,	29/- to 30/-
Best Eastern Valley Large	28/- to 29/-
Ordinary ,, ,,	27/6 to 28/-
Best Steam Smalls	19/- to 19/6
Ordinary ,,	10/- to 17/-
Washed Nuts	32/6 to 35/-
No. 3 Rhondda Large	35/- to 40/-
,, ,, Smalls	22/6 to 27/6
No. 2 ,, Large	27/6 to 30/-
,, ,, Through	20/- to 24/-
,, ,, Smalls	16/- to 17/-
Coke (export)	60/- to 62/6
Patent Fuel	30/- to 35/-
Pitwood (ex ship)	30/- to 32/6
Swansea—	
Anthracite Coals:	
Best Large	55/- to 57/6
Summds	55/- to 57/6
Red Vein	40/- to 45/-
Big Vein	55/- to 57/6
Machine-made Cobbles	70/- to 72/6
Nuts	72/6 to 75/-
Beans	60/- to 65/-
Peas	42/6 to 45/-
Breaker Duff	12/6 to 15/-
Rubbly Culm	18/- to 20/-
Steam Coals:	
Large	32/6 to 35/-
Seconds	30/- to 32/6
Smalls	15/- to 17/6
Cargo Through	22/6 to 25/-

[1] Delivered. [2] Net Makers' works. [3] At furnaces. [4] Delivered Sheffield. [5] Glasgow, Lanarkshire and Ayrshire. [6] Home Prices—All delivered Glasgow Station.
[7] Export Prices—F.O.B. Glasgow. [8] Prices represent the real market before the *official* change was made. [9] These prices are practically alike now
[10] Sheets reduced while other prices are advancing. [11] Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export.
[12] For inland sales. [13] Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Franco-German Trade.

THE negotiations being carried on between M. Loucheur and Herr Rathenau have a much wider significance than is generally supposed. In arranging for the Germans to supply the bulk of the material and to undertake some of the work of reconstruction the Minister of the Liberated Regions endeavoured to get France out of her present isolated position by opening up a market in Germany. As the result of the tariff war French manufacturers find themselves largely deprived of their foreign trade, and the fear that the opportunities for recovering ground in the export markets will become remote in view of the growing German competition had much to do in reconciling the French to the idea of the Germans taking a share in the reconstruction work. The official explanation that if the energies of the Germans are directed to the rehabilitation of the devastated areas they will leave the way open to the French to do business in foreign markets may be taken for what it is worth. The real reason is the conviction that there is no hope of the reconstruction being carried out in the present state of the national finances without the assistance of the Germans, who will, in that way, contribute to what is due for reparation. There is also a growing feeling that as all other methods of reviving trade have failed there is nothing left but to see whether something cannot be done by means of a commercial arrangement with Germany. It is evidently with the intention of preparing the country for this reversal of policy that so much prominence has been given to the negotiations reported to be in progress between our erstwhile enemies and Great Britain and Italy. There is no doubt that in his negotiations for reconstruction work M. Loucheur has laid the basis of an agreement for a freer interchange of products between the two countries. The idea of a possible alleviation of the existing prohibitive import duties on German goods is already creating some alarm amongst certain branches of industry, notably the machine tool firms, who declare that if the Germans are permitted to export to France they will be ruined.

An International Agreement.

On the whole there appears to be a slight improvement in the industrial situation, and many of the engineering shops have been able to re-engage some of the men who were recently discharged. In a general way, however, the rather better employment is due to the acceptance of foreign business at such low prices that profits have been cut to vanishing point. At the same time the higher import duties have not shut out foreign goods, from which it is evident that manufacturers abroad are also making considerable sacrifices in order to keep their men employed. The first result of the tariff war has been therefore a ruinous cutting of prices for foreign business, and if this state of things continues the situation will be extremely bad for all the countries concerned. In the hope of avoiding a collapse it is stated that the manufacturing interests in some of the allied countries have been approached with a view of seeing whether an international arrangement can be come to for facilitating business. In view of the fact that nothing came of the recommendations of the Brussels Conference soon after the Armistice, when the matter was fully discussed by the world's leading experts, it is perhaps too much to hope that the proposed negotiations will give any satisfaction.

Miners' Wages.

The decision of the coalowners in most districts to reduce wages by 15 per cent. is being strongly resisted by the miners' union, which held a meeting during the past week, at which resolutions were passed threatening trouble if the owners continued to insist on the reduction. The miners took their stand on the ground that the companies were making "scandalous profits" and could therefore afford to pay the higher wages which, they claim, are no more than proportionate to the increase in the cost of living. As a matter of fact, taking the average for the whole country, the miner's wage in 1913 was 5.40f. and in 1920 19.90f., representing an increase of 368 per cent. Even a year ago this increase was greater than that in the cost of living, and since then the latter has been steadily declining to a far greater extent than the 15 per cent. reduction imposed by the coalowners. So far as concerns the "scandalous profits," the men fail to take into account the considerably higher charges imposed upon coalowners and the heavy fall that has taken place in coal prices during the past year, which make it very difficult to understand how such profits could have been obtained. The threat of a strike over the wages reduction question cannot be ignored, for while the men can have no hope of a successful issue they may be drawn into a strike in sympathy with the labour movement in the North.

Locomotives.

The situation of the locomotive builders is so precarious that the successful efforts of competitors in other countries to secure orders are awakening a good deal of interest. For a recent contract for Bulgaria some French firms submitted tenders lower than the Belgians and only a little above those sent in by Hungarian builders, and yet a Belgian firm has succeeded in securing an order from the North of Spain Railways for twenty locomotives and tenders. Now it is reported that a British firm has obtained a large contract for locomotives from one of the States in Eastern Europe where the exchange rate is particularly depreciated. According to French reports the contract was only obtainable with the aid of the British Government, which covered the buyer's liability by accepting bonds in payment. It is suggested that French locomotive builders cannot hope to do business abroad unless the Government grants similar facilities, which is indeed practically equivalent to the system of credits proposed some time ago, but while many propositions have been made and favourably received for enabling manufacturers to secure orders in countries with a depreciated currency, nothing so far has been done.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

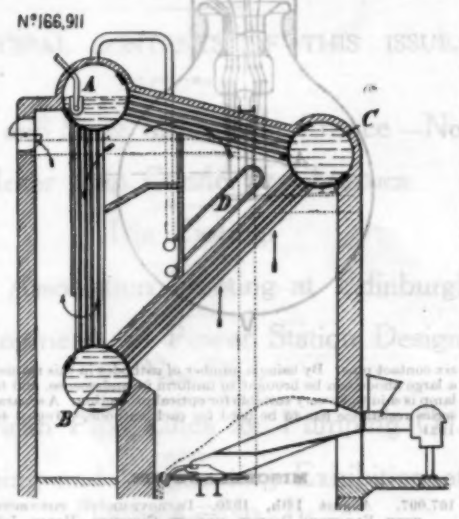
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

166,911. June 15th, 1920.—IMPROVEMENTS IN OR RELATING TO WATER-TUBE STEAM BOILERS OR GENERATORS, Charles Erith, of Winchfield, Albion-road, Sutton.

This boiler works with a ring flow circulation, and has a single steam and water drum A, which is situated at the rear of the boiler. It also has a mud drum B, which is placed at a suitable distance below the steam drum, and a water drum C at the front of the

N°166,911



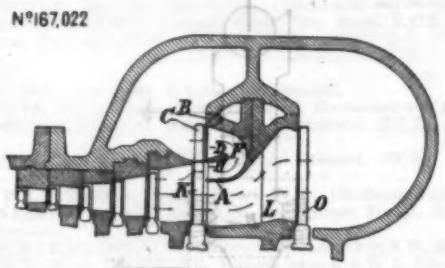
boiler. The arrangement of the tubes is self-explanatory. Baffles are arranged to direct the hot gases first through the lower bank of steeply inclined tubes, then through the upper bank of less inclined tubes, and finally through the bank of vertical tubes. D is a superheater. An economiser may also be fitted to the boiler, but this is not shown.—*August 4th*, 1921.

STEAM TURBINES.

167,022. May 18th, 1920.—IMPROVEMENTS IN ELASTIC FLUID TURBINES, John Chittenden, of 90, Hillmorton-road, Rugby, and George Arrowsmith, of Oakleigh, Bilton, near Rugby.

In the case of the example illustrated, as the steam leaves the moving blades of the fifth stage, it is directed into two paths by the annular guide plate A, which is curved and delivers the steam into the guide ring B. It then enters the ring of blades C, which form the sixth stage of the turbine. To co-operate

N°167,022



with these blades a ring of fixed blades D is provided in the outer end of the guide passage, formed by the plate A, outer ring B and inner ring F. Blades may also be provided at H. The undiverted part of the steam, leaving the blades K, passes to the stationary blades L, and then into the running blades O on the last wheel of the turbine.—*August 4th*, 1921.

TRANSFORMERS.

146,129. January 22nd, 1916.—IMPROVEMENTS IN RADIATORS OR LIQUID COOLERS APPLICABLE ESPECIALLY TO ELECTRIC TRANSFORMERS, The Pressed Metal Radiator Company, of West Pittsburg, U.S.A.

The radiators each comprise two headers A and B, which are

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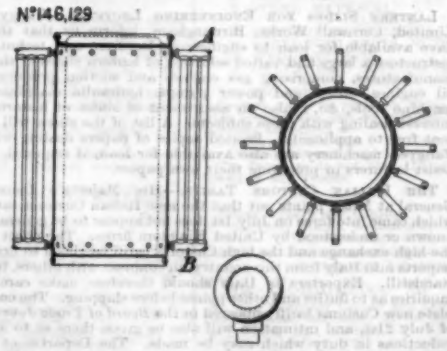


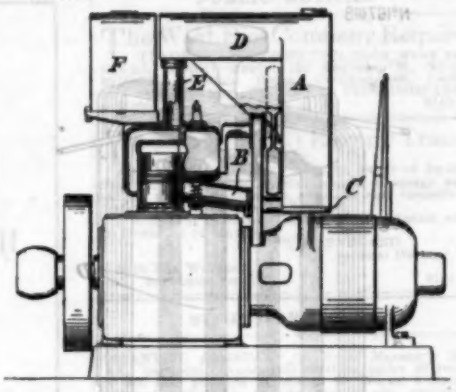
connected together by a series of thin metal tubes, which are secured to the headers by welding or brazing. These thin metal tubes are preferably of oblong, flattened or oval cross section.—*August 4th*, 1921.

INTERNAL COMBUSTION ENGINES.

147,214. July 9th, 1919.—IMPROVEMENTS IN OR RELATING TO ELECTRICAL GENERATING UNITS HAVING AN INTERNAL COMBUSTION ENGINE AS THE PRIME MOVER, Herbert Douglas Shamberg, of 149, Broadway, Manhattan, New York.

The object of this invention is to provide a compact encased structure, an efficient cooling system and a large storage space for the cooling water. The generator supports the radiator A.

N°147,214



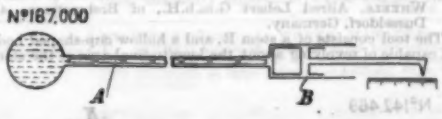
A cold water or return conduit B connects the part C with the lower part of the engine jacket. At the top of the radiator is a tank D, which is connected with the top of the engine jacket by a vertical uptake E. The fuel tank is shown at F.—*August 4th*, 1921.

MEASURING AND TESTING INSTRUMENTS.

167,000. April 29th, 1920.—IMPROVEMENTS RELATING TO TUBES OR CONDUITS FOR TRANSMISSION OF MOVEMENT BY MEANS OF LIQUIDS, Henry Noel Negretti, Paul Ernest Negretti, Marcus William Zambra and George Julius Zambra and Harold William Ibbott, all of 38, Hatton-garden, E.C. 1.

This invention relates to tubes or conduits used for containing liquids by which a movement at one end of the conduit is transmitted to the other end, with the object of actuating an indicator, such as a distance thermometer. When the tube and liquid are subject to variations in temperature, an error may occur, and the object of the invention is to overcome this difficulty. The bore of the tube is partly filled by a core A, formed

N°167,000



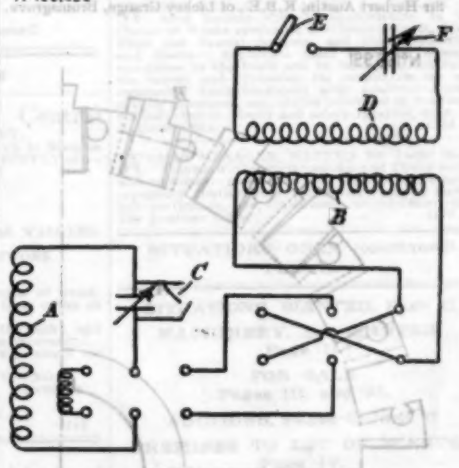
of a rod of wire having a low coefficient of expansion, such as 36 per cent. nickel steel, and the rod is cut into lengths as shown. Similarly, the interior of the cylinder B is partly filled by a block of similar material. The walls of the bulb, tube and cylinder are preferably formed of a steel having a high coefficient of expansion, such as 20 per cent. nickel steel, and the bulb and the remaining space within the tube B and the cylinder C are filled with mercury.—*July 29th*, 1921.

WIRELESS TELEGRAPHY.

166,958. April 23rd, 1920.—IMPROVEMENTS IN WIRELESS DIRECTION-FINDING APPARATUS, Charles Kingsley Chanden, of Calshot, of Direction-finding Wireless Section, Air Navigation School, Royal Air Force, Calshot, Hampshire.

This invention relates to a simplified system for correcting quadrantal error, caused by waves producing currents in the metal parts of aircraft before the waves reach the direction-finding aerials, and is particularly suitable for use on aircraft in connection with ascertaining the bearing of a transmitting station. The bonding of the metal parts together, in accordance with this system, has the effect of making the quadrantal error curve a pure sine wave and the formula for the correct capacity

N°166,958



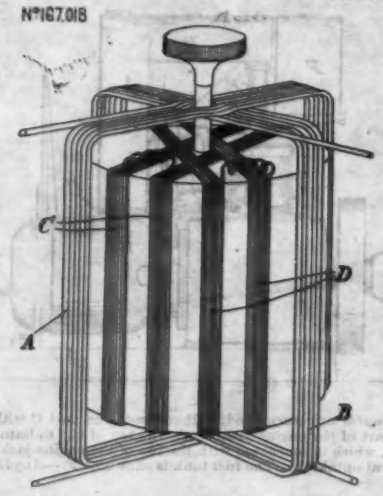
for the corrector coil becomes identical with that for the quadrantal error, so that a change switch for different wave lengths is unnecessary. The quadrantal error is eliminated by the operator adjusting the capacity of the condenser after it has been calibrated. Two rotatable aerial coils A and B at right angles can be connected to the detecting device shown at C, so that the direction of the transmitting station

can be obtained in the known manner. D is a corrector coil coupled to the aerial coils and connected in series with a switch E and variable condenser F.—*July 25th*, 1921.

167,018. May 12th, 1920.—IMPROVEMENTS IN RADIOGONIOMETERS, ESPECIALLY SUITABLE FOR USE IN WIRELESS DIRECTION FINDING, George Maurice Wright, of Lyngrove, Cromwell-road, Chesterfield.

In direction-finding systems employing two fixed frame aerials in conjunction with a radiogoniometer, it is in some cases advantageous to employ a radiogoniometer which will give a very tight coupling between the aerial and search coil circuits. With such an arrangement, however, inaccuracies occur in the readings, and the primary object of this invention is to provide a radiogoniometer in which these inaccuracies are eliminated. A and B are the two aerial coils, and C and D the two windings

N°167,018



of a search coil arranged substantially in planes making an angle of 45 deg. with one another. These windings are arranged upon the surface of a cylinder which can be rotated by means of a handle. The coils are connected in series. The total electromotive force induced in the windings by the currents in the two aerials is the algebraic sum of the electromotive forces in the individual coils, and although the difference of each electromotive force from the ideal case may be quite considerable, yet since the differences are of opposite sign, they cancel out, and the radiogoniometer reads correctly in all positions.—*April 4th*, 1921.

MACHINE TOOLS AND SHOP APPLIANCES.

142,469. January 8th, 1916.—TOOLS FOR TURNING EMERY WHEELS, Alfred Lobert G.m.b.H., of Brehmstrasse 41, Dusseldorf, Germany.

The tool consists of a stem R, and a hollow cup-shaped body K, capable of revolving about the longitudinal axis of the stem.

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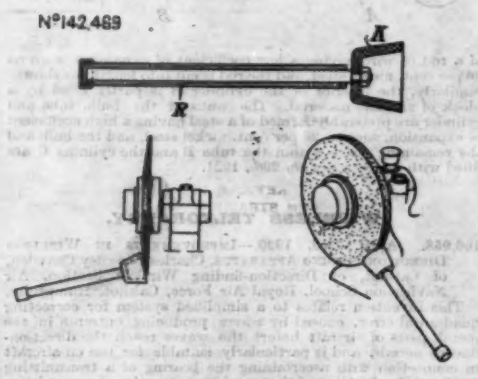
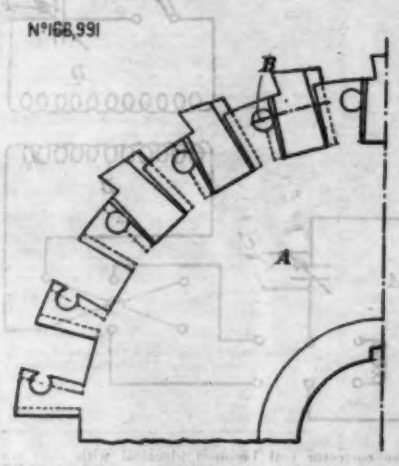


The cup-shaped body is made of carborundum or a similar grinding material. The method of using the tool is shown in the lower illustrations.—*July 26th*, 1921.

166,991. April 28th, 1920.—IMPROVEMENTS IN MILLING TOOLS, Sir Herbert Austin, K.B.E., of Lickey Grange, Bromsgrove.

N°166,991



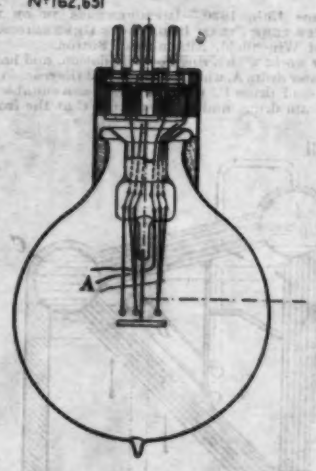
Each cutter has a base portion formed as a true cylinder or part of a cylinder, and correspondingly shaped recesses are formed in the periphery of the disc A. Each cutter is retained in its respective recess by a transverse pin which lies within a correspondingly shaped transverse hole B formed partly in the cylindrical surface of the base of the cutter and partly in the wall of the radial recess.—*July 28th*, 1921.

LIGHTING AND HEATING.

162,651. April 28th, 1920.—TUNGSTEN ARC LAMPS, Patent-Treuhand-Gesellschaft für Elektrische Glühlampen m.b.H., Ehrenbergstrasse 11–14, Berlin, O. 17.

Hitherto lamps of the above kind have had only one cathode associated with the anode, but the lamp described in this specification has a plurality of cathodes, as shown at A in the drawing, and altogether there are six leads, which are joined up to

N°162,651



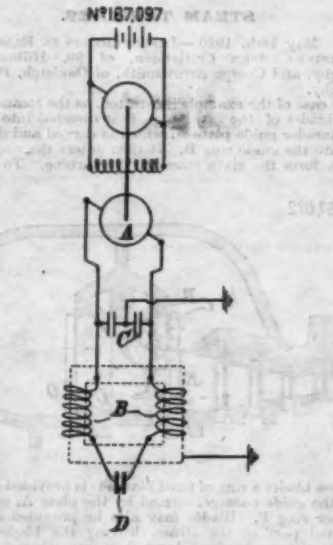
six contact pins. By using a number of cathodes in this manner, a large anode can be brought to uniform incandescence, and the lamp is said to be very suitable for optical projection. A separate series resistance has to be used for each cathode.—*August 4th*, 1921.

MISCELLANEOUS.

167,097. August 18th, 1920.—IMPROVEMENTS CONNECTED WITH ELECTRIC DIRECT-CURRENT CIRCUITS, Henry John Warner, of the Instrument Design Establishment, Biggin Hill, Kent.

Choking coils are inserted in each lead of a direct-current circuit, wherein there is a variation of the voltage, the object of the choking coils being to reduce the amplitude of the variations. The two choking coils are coupled together by an iron core, so as to increase the effective inductance of each coil.

N°167,097



The coupling of the choking coils is said to produce an improved smoothing effect, so that a more constant voltage is obtained. In the diagram the generator is shown at A and the choking coils at B. Two large condensers, shown at C, are connected across the dynamo leads and the centre point of the condensers is earthed. The steady voltage direct current is taken from the terminals D.—*August 4th*, 1921.

LANTERN SLIDES FOR ENGINEERING LECTURES.—Tangyes, Limited, Cornwall Works, Birmingham, inform us that they have available for loan to engineering lecturers and technical instructors a large and varied selection of lantern slides of their manufactures, comprising gas engines and suction producers, oil engines, steam and power pumps, hydraulic machinery, machine tools, &c.; also an assortment of slides of historical interest dealing with these subjects. A list of the slides will be sent free to applicants. Printed copies of papers dealing with Tangyes machinery are also available for loan, if required, to assist lecturers in preparing their own papers.

THE ITALIAN CUSTOMS TARIFF.—His Majesty's Consul-General at Milan points out that the new Italian Customs tariff which came into force on July 1st does not appear to be generally known or understood by United Kingdom firms. The effect of the high exchange and the high Customs tariff has been to bring imports into Italy from this country, in common with others, to a standstill. Exporters to Italy should therefore make careful inquiries as to duties and other points before shipping. The complete new Customs tariff appeared in the *Board of Trade Journal* of July 21st, and intimation will also be given there as to any reductions in duty which may be made. The Department of Overseas Trade, 35, Old Queen-street, Westminster, S.W. 1, is also prepared to render assistance to inquirers in respect of these matters.

Forthcoming Engagements.

MONDAY TO SATURDAY, SEPTEMBER 5TH TO 10TH.

IRON AND STEEL INSTITUTE.—Autumn meeting in France.

TUESDAY, SEPTEMBER 6TH.

ROYAL METEOROLOGICAL SOCIETY.—Edinburgh meeting. Excursion to Eskdalemuir. An excursion by motor coach is being arranged to visit Eskdalemuir Observatory, starting from Edinburgh at 9 a.m., provided a sufficient number of Fellows notify their intention of joining in the excursion. The return journey will commence at 4 p.m.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 7TH TO 14TH.

BRITISH ASSOCIATION.—Annual meeting in Edinburgh. For programme see page 154.

WEDNESDAY, SEPTEMBER 7TH, TO WEDNESDAY, SEPTEMBER 28TH.

THE SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia.

THURSDAY, SEPTEMBER 8TH.

ROYAL METEOROLOGICAL SOCIETY.—Edinburgh meeting. Meteorological luncheon. A luncheon open to members of the British Association interested in meteorology and to Fellows of the Society is being arranged for Thursday, September 8th, at 1 p.m. Fellows wishing to be present should give in their names to the assistant secretary not later than at the ordinary meeting on September 7th.

FRIDAY, SEPTEMBER 9TH.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—By invitation of Mr. Geo. Hughes, C.B.E., chief mechanical engineer, Lancashire and Yorkshire Railway, the members of this Institution will visit the Clifton Power-house, at Clifton Junction. Special train leaving No. 1 platform, Manchester (Victoria) Station, at 2 p.m. prompt.

MONDAY, SEPTEMBER 12TH.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON) LEEDS CENTRE.—Visit to the locomotive works of Sir W. G. Armstrong, Whitworth and Co., Newcastle. Meet at the main entrance of the locomotive works at 2 p.m.

WEDNESDAY, THURSDAY, AND FRIDAY, SEPTEMBER 14TH, 15TH, AND 16TH.

INSTITUTION OF MINING ENGINEERS.—Town Hall, Stoke-on-Trent. For programme see page 239. 11 a.m.

WEDNESDAY, THURSDAY AND FRIDAY, SEPTEMBER 21ST, 22ND, AND 23RD.

THE INSTITUTE OF METALS.—Autumn meeting in Birmingham. For programme see page 161.

SATURDAY, OCTOBER 8TH.

ASSOCIATION OF ENGINEERS-IN-CHARGE.—Holborn Restaurant, London. Twenty-first annual dinner. 6 p.m.

MONDAY, OCTOBER 10TH.

INSTITUTE OF TRANSPORT.—Victoria Hall, Hotel Cecil, London, W.C. 2. Second Institute Dinner. 7.30 p.m.

LAUNCHES AND TRIAL TRIPS.

LORIENT; steel screw steamer for coal-carrying traffic; built by the Tyne Iron Shipbuilding Company, Limited, to the order of Paris Orleans Railway Company; dimensions, 372ft. by 53ft. by 26ft.; to carry 7000 tons deadweight. Engines, triple-expansion, 23½in., 38in. and 64in. by 42in. stroke, pressure 180 lb.; constructed by Sir W. G. Armstrong, Whitworth and Co., Limited.; trial trip, Saturday, August 27th.

AABENRAA; cargo steamer; built by Yarrow and Co., Limited, to the order of Nord-Osterso Rederiet, of Copenhagen; dimensions, 286ft. by 43ft. 6in. by 21ft.; to carry 3500 tons deadweight (gross tonnage 2211). Engines, triple-expansion, 20½in., 33in. and 54in., by 36in. stroke, pressure 180 lb.; constructed by the builders; launch, Wednesday, August 31st.

DINTELDIJK; twin screw motor vessel; built by Harland and Wolff, Limited, to the order of Holland-American Line; dimensions, 502ft. by 62ft. by 39ft. 6in.; gross tonnage 9500. Engines, two sets of four-stroke cycle Diesel engines, each having eight cylinders; constructed by the builders; launch, Thursday, September 1st.

LONDON MARU; steel screw cargo steamer; built by Cammell Laird and Co., Limited, to the order of the Osaka Shosen Kaisha of Japan; dimensions, 450ft. by 55½ft. by 35½ft.; displacement, 15,500 tons; to carry 10,000 tons deadweight. Engines, single-screw double-reduction geared turbine machinery; constructed by the builders; launch, Saturday, September 3rd.

MOSELLA; twin-screw passenger and cargo liner; built by Swan, Hunter and Wigham Richardson, Limited, to the order of Cie de Navigation Sud Atlantique of Paris; dimensions, 481½ft. by 59½ft. by 38ft.; to carry 9000 tons. Engines, twin set of Brown-Curtis double-reduction geared turbines; constructed by Wallsend Slipway and Engineering Company, Limited; to carry 1000 persons; launch, Saturday, September 3rd.

POITIERS; steel screw steamer for coal-carrying traffic; built by Tyne and Iron Shipbuilding Company, Limited, to the order of Paris Orleans Railway Company; dimensions, 364ft. by 52ft. 6in. by 26ft.; to carry 7000 tons deadweight. Engines, triple-expansion, 23½in., 38in. and 64in. by 42in. stroke, pressure 180 lb.; constructed by Sir W. G. Armstrong, Whitworth and Co., Limited; launch, Saturday, September 3rd.

P.L.M. 24; large cantilever-framed steamer; built by Sir Raylton Dixon and Co., Limited, to the order of La Compagnie des Chemins de Fer de Paris a Lyon et à la Mediterranee; dimensions, 400ft. by 50ft. by 31ft.; to carry 8900 tons deadweight. Engines, quadruple-expansion, 23in., 32½in., 47in. and 68in. by 48in. stroke, pressure 220 lb. under Howden's forced draught; constructed by Richardsons, Westgarth and Co., Limited; launch, Monday, September 5th.

LEITRIM; built by Swan, Hunter and Wigham Richardson, Limited, to the order of Cork Steamship Company, Limited; dimensions, 290ft. by 42½ft.; to carry 3100 tons deadweight. Engines, triple-expansion; constructed by the builders; regular line between Manchester and Liverpool and Dutch and Belgian ports; trial trip, Monday, September 5th.

CONTRACTS.—J. Blakeborough and Sons, Limited, Woodhouse Works, Brighouse, Yorks., inform us that they have secured the contract for the supply of valves in connection with the Tanus completion project for the Bombay Municipality. The pipe line, the contract for which we understand has been secured by Messrs. Braithwaite and Co., Calcutta, is approximately 105 miles long. Messrs. Blakeborough's portion of the contract is valued at approximately £23,000.